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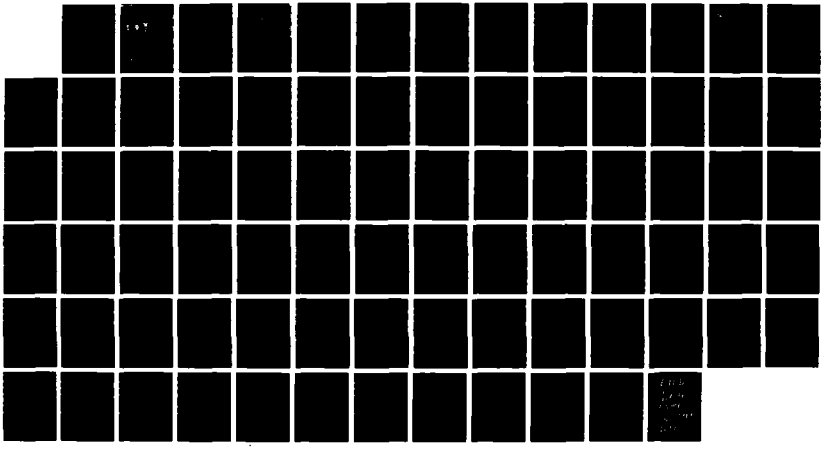

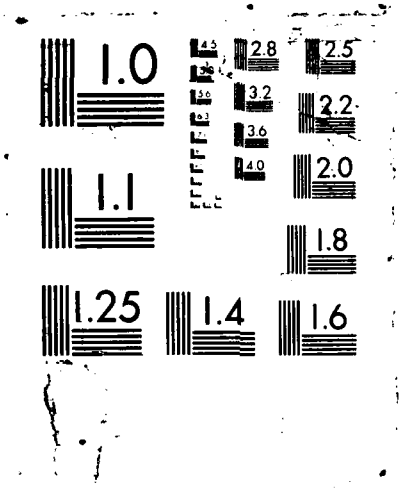
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AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

COMPUTER-AIDED WRITING

MAJOR DAVID A. KING 88-1465

"insights into tomorrow"

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REPORT NUMBER 88-1465

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Submitted to the faculty in partial fulfillment of
requirements for graduation.

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The purpose of this report is to survey the field of computer-aided writing (CAW) tools for use on IBM-compatible personal computer (PC) systems. Computer-aided writing tools include wordprocessors, outline processors and prompting programs, electronic dictionaries, style and grammar checkers, logic analyzers, on-line information systems for research, disk-based references, commenting and review software, desktop publishing and typesetting systems, and hypertext systems. Based on an extensive review of recent PC literature and hands-on evaluation of selected CAW programs, this report discusses various categories of CAW tools, utility of current products, prospects for future developments, and selection and planning criteria. The information presented in this report is intended to acquaint computer resource managers and prospective CAW users with current (as of Feb 1988) PC-based CAW technology. The report also specifically addresses the application of CAW technology at the Air Command and Staff College.

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PREFACE

The production of written communications is an important and time-consuming activity for most professional organizations. Fortunately, it is an activity which is particularly amenable to computer assistance. The rapid and widespread acceptance of personal computers for wordprocessing during the past decade is an example of the successful application of personal computers to this task. Computer-aided writing offers great potential for increased productivity, quality, and convenience. In addition to wordprocessors, computer-aided writing (CAW) tools include outline processors and prompting programs, electronic dictionaries, style and grammar checkers, logic analyzers, on-line information systems for research, disk-based references, commenting and review software, desktop publishing and typesetting systems, and hypertext systems.

The purpose of this research report is to survey the field of computer-aided writing (CAW) tools for use on IBM-compatible personal computer (PC) systems. The information presented in this report is intended to acquaint computer resource managers and prospective CAW users with current PC-based CAW technology. Based on an extensive review of recent PC literature and hands-on evaluation of selected CAW products, this report discusses various categories of CAW tools, utility of current products, prospects for future developments, and selection and planning criteria. The report also specifically addresses the application of CAW technology at the Air Command and Staff College (ACSC) which is the sponsor of this project.

The author wishes to acknowledge the generous assistance of his faculty advisor, Major Michael E. Huffine, ACSC/EDJX, for his review of the drafts of this report and his many helpful comments.

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ABOUT THE AUTHOR

MAJOR DAVID A. KING

Major King is a career Air Force officer with a specialty in electrical engineering and an extensive background in computer systems and software. He was commissioned in the Air Force via Officer Training School in 1975. His most recent assignment prior to attending ACSC was as Instructor in Electrical Engineering in the Department of Electrical and Computer Engineering, School of Engineering, Air Force Institute of Technology (AFIT), Wright-Patterson AFB, OH from January 1983 to August 1987. As a member of the graduate electrical engineering faculty, he taught courses and supervised student research in the areas of communications engineering, digital signal processing, and computer systems. He also served as Curriculum Chairman of Graduate Electrical Engineering Program and as Chief, Artificial Intelligence Division, and was responsible for management of the AFIT Signal Processing Laboratory, a computer facility for research in the areas of digital image and speech processing, pattern recognition, and artificial intelligence. Between 1979 and 1982 he attended the University of Southern California (USC) on an AFIT-sponsored educational tour during which he specialized in computer vision research at the USC Signal and Image Processing Institute. Between 1975 and 1979 he held a variety of software and electronic engineering positions with the E-3A System Program Office, Electronic Systems Division (AFSC), and E-3A System Manager, Oklahoma City Air Logistics Center (AFLC), in which he was responsible for management of the development, test, and support of software and computer systems for the E-3A Airborne Warning and Control System. He has also held civilian engineering positions with the Department of Electrical Engineering at Stanford University, NASA Goddard Space Flight Center, and the U.S. Army Harry Diamond Research Laboratories. His education includes a Bachelor of Electrical Engineering (Summa Cum Laude) from Catholic University of America in 1968; an MS in Electrical Engineering and MS in Operations Research from Stanford University in 1972 and 1974, respectively; and the degree of Engineer in Electrical Engineering from the University of Southern California in 1982. He is a member of the Institute of Electrical and Electronic Engineers (IEEE) and the Association for Computing Machinery (ACM). Upon graduation from ACSC in June 1988, Major King will be assigned to the Defense Communications Agency.

TABLE OF CONTENTS

Preface iii
About the Author iv
Table of Contents v
List of Illustrations vii
Glossary viii
Executive Summary ix

CHAPTER ONE--INTRODUCTION
Background
Impact of Personal Computers on Writing 1
Definition of Computer-Aided Writing 2
Motivation 2
Statement of Problem 2
Objectives 2
Sources 3
Assumptions and Limitations 3
Organization of Report 4

CHAPTER TWO--A TAXONOMY OF COMPUTER-AIDED WRITING TOOLS
Categories of CAW Tools 5
Outline Processors and Prompting Programs 6
Wordprocessors 7
Spelling Checkers and Thesauri
Spelling Checkers 11
Thesauri 13
Punctuation, Grammar, and Style Checkers 14
Logic Analyzers 15
Miscellaneous Utilities 16
File Conversion Programs 16
File Searching Programs 16
Disk-Based References 17
Bibliographic Database Systems 17
Revision Control and Review Software 18
Other 19
Communications and Networking Systems 19
Systems for On-line Research 21
Publishing and Typesetting Systems 21
Hypertext Systems 24

CHAPTER THREE--CURRENT WORDPROCESSORS, OUTLINE PROCESSOR AND STYLE CHECKERS
Introduction 27
Wordprocessors 27
Outline Processors 31
Style Checkers 35

CHAPTER FOUR--CONSIDERATIONS IN SELECTING CAW TOOLS
Introduction 41
Function and Performance 41
System Requirements 42
Training Requirements 43
Standardization and Compatibility Issues 44
Cost, Updating, and Licensing Issues 46
Planning Issues 46

CHAPTER FIVE--APPLICATION OF CAW TOOLS AT ACSC
Background 49
Assessment 50
Recommendations 52

CHAPTER SIX--SUMMARY AND CONCLUSIONS 55

BIBLIOGRAPHY 57

LIST OF ILLUSTRATIONS

FIGURES

FIGURE 1--WordPerfect's Numbering Styles for Outlines 33

FIGURE 2--Text of Example Document 39

FIGURE 3--Analysis of Example Document by PC-Style 39

FIGURE 4--Analysis of Example Document by RightWriter 40

GLOSSARY

ACSC	Air Command and Staff College
AFB	Air Force Base
AFIT	Air Force Institute of Technology
AFP	Air Force Pamphlet
AFS	Air Force Station
AI	Artificial Intelligence
ASCII	American Standard Code for Information Interchange
AT&T	American Telephone & Telegraph
AUL	Air University Library
CAD	Computer-Aided Design
CAI	Computer-Assisted Instruction
CAW	Computer-Aided Writing
CD-ROM	Compact Disk Read Only Memory
CGA	Color Graphics Adapter
CP/M	Control Program for Microprocessors
DCA	Document Content Architecture
DDN	Defense Data Network
DOS	Disk Operating System
DTP	Desktop Publishing
EGA	Enhanced Graphics Adapter
IBM	International Business Machines
K	Kilo (thousand)
LAN	Local Area Network
M	Mega (million)
MCA	Micro Channel Architecture
MHz	MegaHertz (million cycles per second)
OPR	Office of Primary Responsibility
PC	Personal Computer
PCO	PC-Outline
RAM	Random Access Memory
TSR	Terminate-and-Stay-Resident
USAF	U.S. Air Force
VGA	Video Graphics Array
WAN	Wide Area Network
WORM	Write-Once Read-Many
WYSIWYG	What-You-See-Is-What-You-Get

EXECUTIVE SUMMARY

Part of our College mission is distribution of the students' problem solving products to DOD sponsors and other interested agencies to enhance insight into contemporary, defense related issues. While the College has accepted this product as meeting academic requirements for graduation, the views and opinions expressed or implied are solely those of the author and should not be construed as carrying official sanction.

"insights into tomorrow"

REPORT NUMBER 88-1465

AUTHOR(S) MAJOR DAVID A. KING, USAF

TITLE COMPUTER-AIDED WRITING

I. Purpose: To acquaint computer resource managers and prospective users with the ways in which personal computers can be used to assist in the production of written communications.

II. Problem: Computer-aided writing (CAW) tools have great potential for saving labor and improving quality in the writing process. However, CAW technology is new and rapidly evolving. Comprehensive treatments of this subject are not currently available in the literature to guide the computer resource manager or prospective user in selecting or planning for use of this technology. This report provides this needed survey and assessment of CAW tools. In a separate chapter it also specifically addresses the application of CAW technology at the Air Command and Staff College (ACSC).

III. Data: Different classes of CAW tools are designed to assist in the various stages of the writing process from prewriting and research to preparation of final copy for publication. This report discusses the function, utility of current products, and trends and prospects for future developments for ten categories

of CAW tools for use with IBM-compatible personal computers: (1) outline processors and prompting programs; (2) wordprocessors; (3) spelling checkers and thesauri; (4) punctuation, grammar, and style checkers; (5) logic analyzers; (6) miscellaneous utilities; (7) communications and networking systems; (8) systems for on-line research; (9) desktop publishing and typesetting systems; and (10) hypertext systems. Examples of selected current offerings in three of the categories, wordprocessors, outline processors, and style checkers, are discussed in greater detail. The report identifies general factors which should be considered in selecting specific CAW tools, including function and performance, system and training requirements, and compatibility, cost, and planning issues. The report also assesses the current support for computer-aided writing at ACSC and recommends that efforts be concentrated on improving facilities for faculty and staff in the areas of wordprocessing and publishing support, networks, computer and printer upgrades, and investigation of emerging technologies, such as CD-ROMs and hypertext.

IV. Conclusions: The current technical maturity and utility of the aforementioned categories of CAW tools vary significantly. For example, present full-featured wordprocessors and spelling checkers are very powerful and useful, while the performance of current style checkers is quite spotty. The power and utility of CAW tools should increase substantially over the next few years. For PC-based CAW tools, there is a rapid trend toward integrating previously separate CAW tools into wordprocessors. This phenomenon places renewed importance on proper selection of wordprocessing software and strongly favors the selection of one of the more competitive, full-featured products, such as Microsoft Word or WordPerfect. To take full advantage of new developments in CAW technology, hardware upgrades will typically be required, particularly in the areas of graphics and display systems, printers, processor and memory, and communications. Communications networks, CD-ROMs, and hypertext represent very promising technologies for improving access to data and for the preparation and distribution of documents.

V. Recommendations: Organizations interested in taking full advantage of CAW technology should monitor developments in the field since it is rapidly changing. This report recommends as a basic CAW strategy the selection of a wordprocessor or document preparation system which integrates the various CAW tools, including support for graphics and desktop publishing. Organizations must plan for necessary hardware support in addition to CAW software. They should begin experimenting with emerging related technologies, particularly CD-ROMs, hypertext, and networks.

Chapter One

INTRODUCTION

BACKGROUND

Impact of Personal Computer Technology on Writing

The production of written communications has long been a major activity of most business, government, and academic organizations. In the past decade, however, we have witnessed a technological and social revolution in the way written communications are produced due to the widespread adoption of personal computers (PCs) for word and document processing. Since the first primitive systems appeared in the late 1970's, the use of personal computers for wordprocessing has become commonplace in both home and office. PC-based wordprocessing has to a large extent supplanted competing technologies, such as the typewriter, dictation equipment, and dedicated word processor (143:73-75; 146:96-97). It has also significantly altered attitudes and roles in the writing process. For example, it has increased the willingness of writers to revise their work. It has also fostered the tendency of authors to maintain closer control of their work by composing draft and final documents themselves on their personal computers. Along with the development of PC-based wordprocessing have come other tools for computer-aided writing and publishing, such as outline processors, spelling checkers and thesauri, style analyzers, and desktop publishing software, which are currently at widely varying stages of technical maturity and utility. These developments have been spurred on by continuing advances in microprocessor, printer, and disk storage technology; wordprocessing and other applications software; and systems standardization. In the past two years, there have been major technological developments affecting computer-aided writing, including the proliferation of laser printers and graphics systems and large improvements in wordprocessor functionality. It is our intent in this report to provide a concise but comprehensive summary and assessment of this significant and rapidly advancing field of computer-aided writing technology.

Definition of Computer-Aided Writing (CAW)

For the purpose of this report, computer-aided writing (CAW) is the use of a computer system to assist an author, reviewer, or publisher in performing any task associated with the preparation of a written document. This very broad definition spans the entire range of activities involved in writing and publishing a document from initial analysis of communications requirements to preparation of the final camera-ready copy. Accordingly, CAW tools encompass software or systems for such diverse tasks as outlining, wordprocessing, proofreading, and typesetting.

Motivation

The purpose of this report is to acquaint computer resource managers and prospective users of CAW technology with the function and types of CAW tools, capabilities of currently available products, prospects for future developments in the field, and guidelines for selecting CAW tools. This knowledge is useful if one is to take advantage of current technology or is to plan intelligently for future systems. Such information, however, is not readily available due to the lack of comprehensive treatments of the subject in the current literature. This report attempts to present a coherent picture of CAW technology by consolidating inputs from a large number of sources, primarily very recent articles and reviews appearing in trade papers and technical magazines. Finally, the report specifically examines and makes recommendations concerning the application of CAW technology at the Air Command and Staff College (ACSC) which is the sponsor of this research project.

STATEMENT OF PROBLEM

How can computers be applied as aids to writing in general and at ACSC in particular?

OBJECTIVES

1. Develop a taxonomy of computer-aided writing (CAW) tools and describe the general functions and principles of each class.

2. Identify representative examples of current CAW tools, describe their capabilities, and assess their utility.

3. Provide a general assessment of current CAW tools. Summarize current trends and project probable developments.

4. Develop general criteria and guidelines for selecting and applying CAW tools.

5. Assess current computer support for writing and publishing at ACSC and make recommendations for use of CAW tools and for any required improvements to the ACSC computer support environment.

SOURCES

Because personal computer technology changes so rapidly, information on current CAW products is primarily available in recent articles and product reviews appearing in popular computer magazines and trade papers. Additional sources used in preparing this report include articles on CAW and document preparation systems appearing in professional and academic journals on technical communications and computer systems, as well as user's manuals and reference guides for specific CAW programs. Hands-on evaluation was conducted of a number of programs, including PC-Outline, Microsoft Word 4.0, WordStar Professional Release 4.0, XyWrite III Plus, PFS: Professional Write, Smart Word Processor 3.1, PC-Write 2.71, PC-Style 1.04, PC-Read 2.5, and RightWriter 2.1.

ASSUMPTIONS AND LIMITATIONS

1. The reader is familiar with basic concepts and terminology of wordprocessing and personal computers.

2. CAW tools discussed in this report will be generally limited to programs which operate on an IBM PC or compatible system. This class of machines currently represents the largest installed base of personal computer systems in the US and USAF and is the type of machine in use at ACSC. It should be noted, however, that CAW tools are available for other systems, particularly the Apple Macintosh and machines running Unix.

3. Detailed examination and comparison of a large number of CAW tools is beyond the scope of this project. For example, while there are literally hundreds of wordprocessors available for the IBM PC, only four of the most highly rated full-featured wordprocessors are examined in this report. The discussion of specific tools serves primarily to provide examples of significant features, trends, or limitations of current tools.

4. We are concerned with identifying authoring tools which are intended for regular use by writers and other professionals rather than tools which are aimed primarily at teaching students aspects of effective writing. Thus, computer-aided instruction (CAI) and other teaching software or systems will not be addressed in this report.

5. The field of personal computing is very dynamic. New hardware and software are continually being introduced and existing products frequently updated. The reader must recognize that the specific programs and versions discussed in this report are current only as of February 1988. Because of the time-sensitive nature of the information, it will be necessary in the future to update this data for subsequent versions or new products before selecting specific CAW programs. The publications cited in this report are good sources of such product information.

ORGANIZATION OF REPORT

Chapter 2 of this report presents a taxonomy of CAW tools and discusses the general functions and principles of ten categories of tools. This general discussion is followed in Chapter 3 by a more detailed examination of selected examples of three of these categories of CAW tools, namely, outline processors, wordprocessors, and style checkers and a general assessment of the status and trends in CAW tools. Chapter 4 discusses general guidelines and considerations to be observed in selecting and applying CAW tools. In Chapter 5, these guidelines and the other information provided in the preceding chapters are applied to the specific case of use of CAW tools at ACSC. Finally, Chapter 6 provides a general summary of the findings of this research project.

Chapter Two

A TAXONOMY OF COMPUTER-AIDED WRITING TOOLS

CATEGORIES OF CAW TOOLS

Tools for computer-aided writing can be divided along functional lines into the following categories:

1) Outline processors and prompting programs
2) Wordprocessors
3) Spelling checkers and thesauri
4) Grammar, punctuation, and style checkers
5) Logic analyzers
6) Miscellaneous utilities
7) Communication and networking systems
8) Systems for on-line research
9) Publishing and typesetting systems
10) Hypertext systems

Tools in categories 1 through 5 help the author in the basic tasks of writing and editing text and are the main emphasis of this report. Tools in categories 6 through 9 correspond to related tasks, such as research or publishing. Category 10 (hypertext) represents an emerging form of computer-based documentation which is likely to assume increasing significance in the future.

AFP 13-2, The Tongue and Quill, prescribes six steps for effective writing: "(1) analyze purpose and audience, (2) conduct the research, (3) support your ideas, (4) get organized, (5) draft and edit with English that's alive, and (6) fight for feedback" (158:7). Various types of CAW tools address these steps. For example, outline processors and prompting programs address steps 1 and 4; wordprocessors, style and grammar checkers, spelling checkers and thesauri address step 5; review and commenting utilities address step 6.

In the following sections of this chapter, we will discuss each of these classes of CAW tools, including their basic functions, typical usage, significant technical concepts or terminology, special system requirements, examples of current products, an assessment of their utility, and prospects for future developments.

OUTLINE PROCESSORS AND PROMPTING PROGRAMS

An outline processor is a special-purpose editor which permits the user to record, manipulate, and output a hierarchy of notes or ideas in outline form. Outline processors are typically marketed for use by managers and writers as productivity tools in developing and organizing their ideas. (Outline processors are therefore sometimes called thought processors or organizers.) An outline processor can be a helpful tool to the author in the initial stages of the writing process where he is exploring the requirements of the document and developing his high level and detailed outlines. Authorities on effective writing generally recommend making an outline as a preliminary step in writing a document of any significant length or complexity (158:37-38). An outline facilitates brainstorming and organization of facts and ideas and provides a map for the author to follow when actually writing the document. Its condensed form is convenient for assessing whether the planned presentation is logically developed and will satisfy the communication requirements. PC-based outline processors have also found utility for organizing plans and lists, note taking, and rudimentary wordprocessing (because of their built-in editing functions).

The typical outline processor permits the user to enter and edit outline headings and sections of supplementary text and to change their order while the program automatically numbers and indents affected entries. It may support several different formats for numbering and indenting outline entries. It also provides commands for collapsing or expanding the outline to hide or view subordinate levels of the outline, for printing the outline, and for importing and exporting outlines in ASCII or selected outline processor or wordprocessor formats.

Outline processors are available either as add-on programs (e.g., Ready, ThinkTank, More, PC-Outline) or more recently as built-in features of many full-featured wordprocessors (e.g., Word, WordPerfect, XyWrite III Plus, Lotus Manuscript) and integrated software packages (e.g., Symphony 2.0, Framework II). Add-on programs are frequently capable of operating in a memory-resident or terminate-and-stay-resident (TSR) mode so that they are immediately available from within other applications. Outline processors included in wordprocessors are typically implemented as simple extensions of the automatic paragraph numbering function of the basic wordprocessor. Using a wordprocessor that supports multiple windows, the writer can view his outline in one window while simultaneously composing his document in another. Integrated outline processors offer the potential of extending their use beyond simple generation of outlines. For example,

with Microsoft Word's outline feature, a user can automatically compile outline headings into a table of contents. He can also move complete sections of a document simply by rearranging the corresponding headings of the outline.

Current outline processors provide useful automated support for creating and viewing outlines and hierarchical lists (23:--; 61:244) (Note: A detailed discussion of several current outline processors is provided in Chapter 3.) However, this rather specialized support typically comes at the expense of requiring the user to learn a set of additional commands for the outline processor. This learning effort tends to favor the integrated outline processors which reuse the commands of the underlying wordprocessor for their editing tasks over add-on programs which may have large sets of unfamiliar commands. In general, the additional learning effort and skills required to use outline processors limit their applicability to writers who will use them on a regular basis. Writers who have less frequent need for an outline processor may prefer to simply create their outlines on paper or as ordinary documents using their regular wordprocessor. Integrated outline processors which provide features for structuring documents in addition to generating outlines can be very useful for preparing large documents. This type of enhanced outline processor is likely to become more common in the future as wordprocessors take on more of the features of document preparation systems.

Prompting programs work by asking the author questions about the goals and subject of the document. The purpose of such dialogs is to guide and stimulate the writer in exploring and focusing his subject, developing details of his topics or approaches to it, or in overcoming writer's block. A current PC-based example of this type of tool is ThoughtLine which conducts a dialog with the writer and then attempts to render an initial outline of the document (20:--; 64:52-53). An example of a Thoughtline dialog and analysis is given in reference 112. This dialog is strangely reminiscent of the venerable pseudo-AI program, Eliza, which mimics the dialog between a psychoanalyst and his patient (17:Ch 14). Present software in this category is, however, primitive and of debatable effectiveness in improving writer productivity (61:244-245). Future advances in artificial intelligence (AI) technology may improve this situation.

WORDPROCESSORS

Wordprocessing software represents the most developed, widespread, and useful class of current CAW tools. In their basic form wordprocessors serve three primary functions: (1) entry, editing, and retrieval/storage of text; (2) document

formatting; and, (3) document printing. Their operation mimics a typewriter except that text is displayed on a video screen (and simultaneously stored in internal memory and/or on disk) rather than printed immediately. Depending on the available hardware and software, text and possibly graphics can be inputted from keyboard, mouse, optical scanner, communications link, or existing files. Basic text editing commands allow the user to control the position of the cursor on the screen, to scroll text vertically or horizontally on the display, and to insert or delete text. Additional commands are normally available for search and replace operations, block operations, file retrieval and storage, formatting, and printing. Commands are typically activated by a combination of cursor, alt, control, shift and function keys or by use of a mouse. Other approaches to user interface include use of menus or separate text input and command modes (147:90). The large number of commands typically available in a sophisticated wordprocessor can constitute a significant learning obstacle for the new user or for the experienced user who must contend with multiple systems. For example, a typical wordprocessor may provide the following options just for simple cursor movement: move up (or down) one line; move left (or right) one character, tab position, or word; move to the beginning (or end) of line or to the top (or bottom) of a screen, page, or document file; move forward (or backward) one screen, sentence, paragraph, or page; move to a specific page, line number, or marker (18:3-10 - 3-11). Options for document formatting are usually particularly numerous and complex.

Wordprocessors are distinguished from ordinary computer text editors (also known as ASCII or programmer's editors) primarily by their support for document formatting (1:561). The wordprocessor records document formatting instructions by inserting codes into the file being edited, e.g., to specify justification, fonts, margins, columns, etc. (Note: Lack of standardization of these formatting codes accounts for the difficulty in retaining formatting when transferring document files from one wordprocessor to another.) When the resulting document file is printed, the wordprocessor interprets these codes and translates them to the specific command codes for the printer being driven to generate the desired formatted printout. Similarly, when a section of the file is scrolled into view on the screen, the wordprocessor interprets the formatting codes and generates the corresponding display. (Note: In selecting a wordprocessor, it is therefore important that it supports the specific printer and display system it will be used with.) However, because of speed considerations and the limitations of current PC display systems, most IBM PC-based wordprocessors do not produce true "what-you-see-is-what-you-get" (WYSIWYG) video displays, i.e., appearance of text on the screen does not exactly match the appearance of the final printed output (147:90). For example, most current wordproces-

sors using text-based video systems may be able to display underlined and bold characters on the screen but not italics or super/subscripts.

Another distinguishing characteristic of wordprocessors is entry of text using the "word wrap" feature. In this mode, the user enters text without having to explicitly enter a carriage return as one would do with an ordinary text editor. The editor automatically forces a word to the next line or hyphenates it when it extends beyond the right margin. The program is subsequently able to determine the end of line based on insertion of a formatting code such as a "soft" carriage return or hyphen or by calculations based on formatting specifications for font size and line width applicable to that part of the document.

The first highly successful wordprocessor for personal computers was WordStar which was released for the 64K CP/M systems in 1979 (143:75; 146:96). The introduction of the IBM PC in August 1981 and its subsequent establishment as a de facto hardware and software standard gave rise to widespread acceptance of personal computers for both business and personal use. This created a market for a large number of additional sophisticated wordprocessing software packages as well as other applications, such as spreadsheets, database management, and integrated packages. Since its introduction, wordprocessing has consistently ranked as the most common activity on personal computers (143:73-74). Wordprocessors are available as standalone products (e.g., Word, WordStar, WordPerfect, XyWrite III Plus, PC-Write, PFS: Professional Write) or as parts of integrated software packages (e.g., Enable, Smart, Symphony, Framework). It is common to categorize wordprocessors on the basis of cost and features. Full-featured wordprocessors, such as WordPerfect 4.2, Microsoft Word 4.0, WordStar Professional Release 4.0, and XyWrite III Plus, now typically include support for such enhancements as an undo function, columns, headers and footers, sorting, math, generation of table of contents and indices, importation of data from other sources such as spreadsheets, macros (ability to save and recall a sequence of keystrokes or commands), mail merge, windows, automatic hyphenation, automatic paragraph numbering, hidden annotations, redlining, document comparison, proportional type, support for laser printers, and limited line and box drawing capability (88:--; 146:166-205; 147:--). (See Chapter 3 for further discussion of these four wordprocessors.) Lower-priced wordprocessors may lack some of these features, restrict the size of the document file to the amount of available RAM, or limit the number of printers they support (41:--; 126:--). Extreme competition in the field has tended to blur the functional differences among the better general-purpose wordprocessors. The more demanding requirements of technical documents and academic publications have also given rise to the development of a host of technical and

specialized word and document processors (e.g., Lotus Manuscript, Dragonfly's Nota Bene, CMI Software's TechWriter), which provide additional support for mathematical symbols and equations, foreign alphabets, and bibliographic references (75:--; 165:--; 178:--).

Recently, both high and medium cost wordprocessors have increasingly incorporated other CAW tools, such as spelling checkers, thesauri, outline processors, and generators for indices and tables of contents which were formerly available only as add-on programs. This trend is likely to continue for competitive reasons and result in wordprocessors becoming the primary delivery vehicle for other types of CAW tools. Another apparent trend is increased emphasis on graphics for user interfaces, WYSIWYG displays, and printer output to support typesetting, graphics in documents, and more elaborate document formatting. This trend towards graphics in IBM PC-based wordprocessors (already common on the Apple Macintosh) has been spurred by the recent growth of low-cost laser printers, desktop publishing systems, and improvements in PC display systems (e.g., higher resolution standards, graphics coprocessors, RAM font technology). It is likely that future wordprocessors will incorporate many document processing features currently available only in desktop publishing systems. Already many general-purpose wordprocessors include extensive support for different fonts on laser printers and limited capability for importing and positioning printer-ready graphics files.

In the short time since their introduction, PC-based wordprocessors have evolved to very sophisticated products and have become indispensable tools for many writers and editors. There are still some general areas for improvement in these products, including more intuitive user interfaces and command formats, increased speed, support for graphics and document processing, true WYSIWYG displays, and better compatibility with other applications and system software. The advantages of wordprocessors come primarily from their labor-saving support for text entry, quick corrections and revisions, complex formatting, and reuse and merging of existing data. These advantages, along with advanced features such as integrated spelling checkers, facilitate the production of higher quality documents; however, the quality of a document ultimately depends on the writing skills and knowledge of the author and editor. Use of word and document processors also has the advantage of forcing the creation and storage of documents in computer-readable form which can then readily be stored and accessed, reused, distributed electronically, or printed on demand. (1:563; 25:--)

SPELLING CHECKERS AND THESAURI

Spelling Checkers

Misspellings are a common and embarrassing type of error in written communication which can be readily avoided by use of a spelling checker. Spelling checkers proofread a wordprocessed document for misspellings (and possibly other errors such as double words). They are available as standalone programs (e.g., Turbo Lightning, Reference Set, Webster's New World Spelling Checker, MicroSpell, IBM Word Proof II) and more recently as integrated features in most popular wordprocessors (e.g., WordPerfect, WordStar Professional, Word, XyWrite III Plus, PFS: Professional Write, Multimate Advantage II, Manuscript, DisplayWrite 4, PC-Write 2.71). Hardware-based spelling checkers are also available such as the Xerox PC Type Write, a box which is connected between the keyboard and the PC and checks spelling of words as they are entered (82:--). Similar capabilities are also now included in many electronic typewriters.

Software-based spelling checkers are typically used in batch mode where they scan an entire document or selected part thereof for misspellings after the text has been entered. An option to check a single word is usually also provided. As the checker encounters a word it does not recognize (i.e., not in its dictionary and therefore a possible misspelling), it pauses and displays the suspect word in context. It then attempts either automatically or on command to suggest possible correct spellings. The program provides the option for accepting a suggested correction, typing in another spelling, adding the flagged word to a user or temporary dictionary so that further occurrences of the word will not be flagged as errors, or ignoring the alleged error. When making a correction, the checker replaces the misspelled word in the text of the document without the user having to type it. In some implementations the basic spelling correction engine can be used to provide automatic correction capability and automatic replacement of user-defined abbreviations with the fully expanded text. For example, the spelling checker in XyWrite III Plus is able to replace "thier" with "there" or to expand "asap" to "as soon as possible" without user intervention. Many spelling checkers can also operate in a real-time mode in which the spelling of each word is checked as it is entered from the keyboard. This mode of operation, however, may be distracting as the programs beep or pause whenever the typist enters an unrecognized word (61:246).

Storage requirements for the dictionary and program files for spelling checkers favor use of a high capacity disks or full complements of main memory. Advanced data compression schemes are used to reduce the size of the dictionaries which still typically

consume on the order of 100K+ bytes. A few spelling checkers, such as XyWrite III Plus or MicroSpell by Trigam Systems, load their entire dictionaries into memory (RAM) to achieve very significant improvements in speed of execution.

In the past few years, microprocessor-based spelling checkers have quickly evolved from relatively crude offerings which simply flagged words not in their relatively small dictionaries to very practical programs which offer large (100,000+ word) dictionaries and correction capabilities based on character pattern matching or phonetic matching (52:--). Current spelling programs differ primarily in the size and contents of their main dictionaries, speed of execution, convenience of use, ability to suggest the appropriate correction, facilities for tailoring word lists via user or temporary dictionaries, and handling of special cases, such as capitalization. Most popular wordprocessors have recently begun to include excellent spelling checkers as standard features. Lack of a spelling checker is therefore now regarded as a significant deficiency in a wordprocessor. Because of this development and the convenience and performance of integrated checkers, standalone products are now declining in importance. A recent comprehensive review of 31 spelling checkers (20 standalone, 8 integrated, 1 hardware-based) is provided in reference 99. (Note: This review gives highest ratings to the spelling checkers integrated in XyWrite III Plus and WordPerfect.) Another excellent discussion of spelling checkers appears in reference 52.

Further improvements in correction capabilities of spelling checkers are still possible, however, through the use of syntax and semantics. For example, it should be possible for checkers to recognize words misused in context, such as "Deer John" rather than "Dear John." It should be noted that simply adding words to the spelling dictionary can actually increase the probability that an inappropriate word or typing error will match a word in the dictionary (52:95). Thus, careful selection of the contents of the main and user dictionaries to maximize the probability of detection of common misspellings is more important to performance than the absolute number of words in the dictionaries of current spelling checkers. Some vendors of spelling checkers, e.g., WordStar, WordPerfect, and Reference Software Inc.'s Reference Set Library, offer optional dictionaries tailored for specific applications, such as legal, medical, financial, and foreign languages.

Thesauri

Another common application of computerized dictionary technology is the on-line thesaurus. The on-line thesaurus offers synonym-on-demand capability which broadens the writer's choice of words and aids him in eliminating overuse or misuse of words. Thesauri are available as add-on programs (e.g., Turbo Lightning, Reference Set, WordFinder, Webster's On-Line Thesaurus) or increasingly as standard features in wordprocessors (e.g., Word, WordPerfect, WordStar, XyWrite III Plus, PFS: Professional Write). Typical dictionary sizes are 15,000 root words and 220,000 synonyms (51:109-Figures are for Microlytics WordFinder in WordStar Professional Release 4.0). In typical operation, the user places the cursor on the word of text for which he desires a synonym and then activates the thesaurus via a function or control key. The thesaurus then brings up a separate window with a list of synonyms (after a lag of several seconds and assuming the word is in its lexicon) and the user selects the desired synonym with the cursor. Upon striking the appropriate function key, the electronic thesaurus then replaces the original word or word stem with the selected synonym and removes the thesaurus window from the screen. Most thesauri are able to handle common prefixes and suffixes (by stripping them before lookup and reattaching before replacement), to insert the selected synonym in the text in the proper plural form, to maintain correct capitalization, and to change "a" to "an" or vice versa before a word if necessary. Generally it is also possible to select a replacement and then look up its synonyms to obtain a still wider choice of possible replacement words. The various thesauri differ primarily in the choice and number of keywords in their dictionaries and average number of synonyms maintained for each entry (51:--).

Current electronic thesauri are effective and useful CAW tools. They probably find their greatest utility in wordsmithing the final draft of the document. Their principal advantages lie in the convenience of their on-line availability and in their ability to replace a word in a document with a selected synonym without additional typing. The primary limitations of most electronic thesauri arise from abridgment of the synonym dictionaries, requirements for relatively large amounts of disk space (300K+ bytes) to hold the dictionaries, and somewhat slow speed. Widespread adoption of CD-ROM technology could readily eliminate the storage drawbacks of thesauri and other types of on-line references. A excellent discussion of current electronic thesauri is provided in reference 51.

PUNCTUATION, GRAMMAR, AND STYLE CHECKERS

This category of CAW tools includes rule-based style analyzers and automatic document proofreaders. Simple style checkers, such as PC-Style and PC-Read, analyze a wordprocessed document file by computing a readability (grade level) index or similar style metrics based on counting syllables, words, sentences, and occurrences of specific types of words, such as personal pronouns and transitive verbs. Such tools are of minimal value to the serious writer because of the limited nature of their analysis and because they do not actually locate specific errors or offer specific corrections (90:14-15). More sophisticated analyzers, such as RightWriter (177:--), Grammatik II (162:--), and Punctuation and Style, attempt to go further and locate errors in capitalization, spelling, and punctuation and the use of awkward, trite, archaic, and sexist language; passive voice, double words, and homonyms; and long, complex, or incomplete sentence constructions (64:--; 90:--). They also typically generate a marked up copy for review and correction by the author. These programs work from a set of stored rules for grammar, punctuation, and style, and from dictionaries of poor phrases and suggested substitutes. These rules and dictionaries are similar to those contained in common guides on effective writing and preparation of research papers, such as references 2, 10, 11, 15, 156, 158, and 159. Some of these analyzers give the user the option to adjust settings on various indices and modify the phrase dictionaries and word lists to tailor the analysis. However, they are blind to actual meaning (semantics), logic, or literary quality of the document.

Only a handful of style and grammar checkers are presently available for PCs. Current offerings are all standalone programs and are of limited practical utility (90:--). (See Chapter 3 for further discussion.) The performance of this category of tools can be expected to improve in the future via expansion and refinement of their phrase lists and sets of rules, the application of expert systems and natural language processing technology, and rehosting on higher speed processors. For example, none of the currently available PC-based grammar checkers actually parse sentences. Parsing would enable grammar checkers to trap errors such as disagreement in number or person between the subject and verb, incorrect pronouns, etc. as the experimental IBM mainframe-based analyzer Epistle already does (61:247). Such improvements are well within the realm of near-term technical feasibility and should eventually result in useful products in this category. With improved performance and utility, we will then probably see style and grammar checkers being integrated into wordprocessors in much the same way that spelling checkers and thesauri have already been.

Experience with advanced experimental analyzers, such as those in the AT&T-developed Writer's Workbench, indicates marked improvements in writing with the use of such analyzers and recommends their use during initial and final drafts (61:248). This research also indicates, however, that use of such analyzers declines with experience as writers learn to avoid or ignore the errors the analyzer detect or tire of using the tool. This phenomenon is unlike the case of spelling checkers where help with spelling, particularly to proofread the final copy, is regularly needed and requested. This decline in use suggests that until style checkers and analyzers become substantially more powerful and convenient to use that such tools are of limited recurring value to the experienced writer. Furthermore, it implies that highly favorable reviews of products in this class should be viewed with skepticism if based on initial impressions rather than long term use of the product.

LOGIC ANALYZERS

Ultimately, a writer would like to be able to confirm whether his document will be understandable to its intended audience and whether its subject is developed in a logical and coherent fashion. Unfortunately, writing aids for analyzing text at this level are not yet available (61:248). Such analyses require the program to deal with the semantic content of the document, implying artificial intelligence with specific knowledge of the domains of the particular subject, the audience's background and requirements, and the characteristics of effective writing. While limited aspects of this task are being addressed in current research in expert systems and natural language processing, the development of the specific knowledge bases and algorithms to implement such analyzers appears to represent major technological and economic hurdles for the long term. For the foreseeable future, authors will have to rely on their own skills and human editors and reviewers to evaluate and fine-tune these aspects of their writing. Krull and Hulford suggest that in the interim outline processors may provide limited assistance in this task by virtue of their ability to list and rearrange headings and subheadings and to examine the organization of the document with varying levels of detail (61:248). A slightly more sophisticated variation on this approach is exemplified by the ORG program found in the AT&T Writer's Workbench. This tool reduces the document to headings and first and last sentences of paragraphs to give the author an overview of the document and to permit checking of transitions between paragraphs. The analysis of the document for logical organization, however, still rests with the human.

MISCELLANEOUS UTILITIES

This category includes miscellaneous utilities for performing specialized functions not normally included in other classes of tools (144:--). Some example functions and products are described below.

File Conversion Programs

In environments where a number of different wordprocessors are in use, it may be necessary to transfer document files from one wordprocessor to another. As previously discussed, most wordprocessors use different schemes for encoding formatting and other types of information (e.g., headers, footnotes, summaries) in document files. Therefore files created with different wordprocessors are generally incompatible. Many wordprocessors attempt to ameliorate this problem by including functions to read or write files in ASCII format but the resulting files are typically stripped of all formatting codes. A few wordprocessors include utilities for converting files between a limited number of the more popular wordprocessors formats, typically WordStar or IBM Document Content Architecture (DCA) (147:63-94). This problem has given rise to a number of standalone programs which convert files between major PC wordprocessing formats, such as Word-For-Word, WordLink Convert, or R-Doc/X (135:--; 176:--; 179:--, 180:--). For example, Word-For-Word supports conversion between WordStar, WordPerfect, Microsoft Word, XyWrite, PFS: Professional Write, OfficeWriter, Multimate, DisplayWrite, Volkswriter, DCA and ASCII formats (179:--).

File Searching Programs

These are utilities for searching for and retrieving text from files anywhere on a disk. These programs are designed to conveniently search a single file or an entire disk of thousands of files at high speeds for occurrences of specific words or phrases. They typically provide very flexible search requests with combinations of logical functions (AND, OR, NOT), wild cards, upper and lower case matching, near matches, and spatial operators (e.g., WITHIN - specifies how far apart two words or phrases can be). They also normally provide the capability to print the results of the search, save retrieved information to a disk file, and to browse through files. Examples of this category of tools include Microlytics GOfer, The Norton Utilities' Text Search, ZyIndex, TextBase (included with Nota Bene wordprocessor), and Memory Lane (45:--; 46:--; 65:--; 75:--; 129:--; 155:--; 184:--). Most of these programs operate as memory-resident (TSR) pop-up utilities. Programs like ZyIndex and Memory Lane require that files in the search path be indexed prior to requesting a search. This approach requires significant

additional disk space and preparation time over programs like GOfer that do not use indexing. Indexing, however, provides for very fast subsequent searches, e.g., 5 seconds for search of an entire 20 Mbyte disk. This type of utility may also provide support for creating a word-frequency list or concordance. A concordance is an alphabetical list of words or phrases in a document together with their locations or context. A concordance can be analyzed to determine use of particular words and to compile specialized dictionaries and thesauri. An example of a concordance generator is WordCruncher by Electronic Text Corporation (133:--; 134:--).

Disk-Based References

This category of tools provides on-line access to standard reference materials stored on disk. They include the necessary user interface software for searching or browsing the reference and the data for the reference work on disk. The most aggressive product in this category is Microsoft Bookshelf which provides The American Heritage Dictionary, Roget's Thesaurus, The World Almanac and Book of Facts, Bartlett's Familiar Quotations, The Chicago Manual of Style, , U.S. ZIP Code Directory, Business Information Sources, Houghton-Mifflin Spelling Verifier, and Houghton-Mifflin Usage Alert along with their indexes, on a single CD-ROM disk (67:--; 68:--). The package also provides necessary interface software for the PC to access the CD-ROM, search for desired information, and read the text into common wordprocessors. Other references are currently available on CD ROM, including Grollier's Encyclopedia, The Oxford English Dictionary, and Pravda (19:--; 161:--; 175:--). Use of CD-ROM products requires that a CD-ROM player be installed as a peripheral on the PC (requires CD-ROM controller card and software) (161:--). Other more limited references are available for use on conventional hard or floppy disks, e.g., Writer's Handbook by Digital Learning (66:--), AP Stylebook by KeyNotes Inc. (22:--), or Funk and Wagnall's Standard Desk Dictionary by Inductel (31:--). The first two references provide rules and guidelines on writing, punctuation, abbreviation; the third is a 100,000 word dictionary with complete contents including definitions.

Bibliographic Database Systems

These are specialized database systems for managing sets of references that a writer may collect during the research phase. Data may be manually entered into the program or obtained via downloads from supported on-line databases. These tools also provide the capability to produce bibliographies in selected formats and to insert and track references into a document files in ASCII or supported wordprocessor formats. Examples of this type of tool include REFBASE and Reference Manager (93:--).

Revision Control and Review Software

In certain cases it may be desirable to retain a record of all changes to the document. For example, a reviewer may wish to know the specific revisions which have been made to a contract or regulation. Another example is a situation in which a editor modifies a document file but wants the original author to review the changes before finalizing them. This can be done by maintaining previous and current versions of the document file and using a file comparison utility, such as CompareRite (27:--), to detect the differences. A more convenient approach is to "redline" the file. Redlining software, which has been incorporated in some wordprocessors such as Word 4.0 and XyWrite III Plus, marks all additions and deletions in the document file while retaining the original material intact. It also provides the capability to accept or reject a redlined change when finalizing the document.

Another example of software in this category is the ForComment document review program by Broderbund Inc. (42:--; 43:--; 100:242-244) This program allows up to fifteen reviewers to review a document in turn or in parallel by annotating comments to the document file. The originating author can specify a circulation list and individual reviewers can chose to make their comments public or private. After the reviewers have finished their comments and the document file is returned to the originator, he may compile the comments into a collated report, extract and track comments of a specific reviewer, or swap suggested revisions into the target document. The program is capable of operating on a local area net (LAN). A LAN provides a convenient medium for this review process since it is unnecessary to circulate floppy disks to exchange the document files and comments. The LAN permits all reviewers immediate access to the document and allows the author to check on the status of the review at any time. The LAN also promotes additional communication between the author and reviewer via electronic mail or file exchanges. The advantages of such commenting software are subject to debate. For the present, marking up a hardcopy of a document with a blue pencil is probably a simpler and more convenient approach, particularly if few reviewers are involved or a networked environment is not available.

Hidden notes can also be used by an author or reviewer to embed comments, references, or explanatory material directly in the document file. A hidden note is annotated text which can be made visible and edited as needed but which is normally not displayed or printed with the document. Most full-featured wordprocessors have recently added this capability.

Other

Other tasks for which automated support is available include generation of document indices and graphics (charts, graphs, figures, and scanned images). Most manuals and technical documents include an index at the back of the document listing topics and the corresponding pages in the document where they may be found. An example of a standalone program for generating an index is IndexAid by Santa Barbara Software Products (54:--). Built-in indexing facilities are also now included in many high-end wordprocessors, e.g., WordStar, Word, and XyWrite III Plus. Numerous programs for generating graphics are available as components of integrated packages (e.g., Smart, Enable) or spreadsheets (e.g., Windows Excel, Lotus 1-2-3), and as standalone presentation and technical graphics software (e.g., Micrografx Windows Graph (130:--), Harvard Graphics, Freelance, Boeing Graph 3D). Currently the ability of most PC wordprocessors to import or manipulate graphics is very limited (e.g., to including a graphics file in printer-ready format into a wordprocessing file) but this situation should improve siginficantly in the near future. Increased support for incorporating graphics in a document is provided by add-on graphics integration programs and in current desktop publishing systems (see below).

COMMUNICATION AND NETWORKING SYSTEMS

In order to electronically communicate with an on-line data service, library, or remote computer system with dial-in capability, it is necessary to equip a PC with a modem and compatible communications software. The communications software drives the modem port and performs related functions such as terminal emulation, automatic dialing, screen capture, file transfer, unattended operation, and scripting. The modem is a device which converts a series of bits to audio tones and vice versa so that two computer systems can communicate over a telephone channel. Modems are packaged as internal cards or external devices which must be connected to a serial port of the PC. Commonly used transmission speeds are 300, 1200 and 2400 bits per second. Numerous communications programs are available, such as ProComm, Qmodem, PC-Talk, Smartcom, HyperAccess, Crosstalk. Extensive reviews of current modems and most of the aforementioned communications programs are provide in references 50, 78, 84, and 105.

It is becoming increasingly common to link a number of PCs in an organization together in a local area network (LAN) (86:--). LANs permit efficient sharing of expensive resources (e.g., high capacity disks and laser printers) and simultaneous access to program and data files by multiple users from their individual stations. LANs also provide for convenient PC-to-PC communica-

tion (including electronic mail) and considerable flexibility in locating resources or adding new systems to the net, while allowing users to retain the processing capabilities of their individual PCs or workstations. For the writer, the LAN environment offers improved access to files, resources, and users on the net and opens the possibility of multiple authors, editors, or reviewers simultaneously working on the same document. Frequently a LAN is set up with one of the systems equipped with a large amount of disk storage. This system then acts as a central file server for systems on the net. Expensive peripheral devices, such as high-performance laser printers, can also be located at the server or at another node and accessed by any user on the net. This arrangement enables disk storage and files to be centralized and peripherals to be shared, thus reducing hardware requirements at individual workstations, file and equipment duplication, and system management problems. Installation of a LAN typically requires addition of a network interface card and network software on each PC and installation of a cabling system (twisted pair, baseband or broadband coaxial cable, fiber-optics) between the systems. There are currently a large number of competing manufacturers (e.g., Novell, 3Com, IBM, AT&T) producing LAN systems for DOS-based PC's, which vary in topology, transmission media, access control techniques and protocols, hardware and software requirements, services provided, cost, and performance. When multi-user access to files or resources is supported, systems and applications software must be adapted for LAN operation to preclude contention for files and resources, e.g., two users attempting to overwrite each other's editing changes in the same document. Without such modifications, programs must be operated in a single user mode. Examples of releases of applications software which support operation on a LAN include the new versions of the Smart and Enable integrated software packages (57:--). A comprehensive listing of current LAN and other communication products for personal computers is provided in reference 80, pages 153-236. Bibliographies of recent articles and reviews of LAN systems for PCs appear in reference 80, page 43, and reference 103.

For connecting computer systems which are separated by larger distances, wide area networks (WANs) are available. An example of a WAN is the Defense Data Network (DDN). Data traffic between nodes is generally routed over dedicated high-speed common carrier lines or satellite links. Facilities are usually available on WANs for remote logins, file transfer, electronic mail, and teleconferencing.

SYSTEMS FOR ON-LINE RESEARCH

On-line electronic databases now represent a major resource for conducting bibliographic searches, retrieving abstracts and full text of documents, and accessing numerous types of specialized data. Between 1976 and 1985 the number of such systems grew from 301 to 2805 (16:viii). An extensive directory of computer-readable databases is provided in reference 16. Many of these databases are accessible by direct dial-in or through on-line services such as Dialog, CompuServe, The Source, Western Union, etc. (127:--). To access such systems, the PC must be equipped with a modem and a communications program. Some services (e.g., The Source) offer special communications and retrieval programs to simplify the user interface and to automate database searches and file downloads. Charges for access to these databases typically involve a telecommunications or connect charge plus a charge for each search. Special interest forums offered on services such as CompuServe also represent a potential source of information or assistance on selected subjects. Increasingly, computer readable databases are also becoming available on CD-ROM (108:--).

PUBLISHING AND TYPESETTING SYSTEMS

This category of tools is concerned with preparing documents for publication. It includes desktop publishing systems, typesetting software, text formatters, and document processing systems. The design and production of documents for publication is a complex process which is an important part of preparing articles, manuals, and books. Because of the development of relatively low-cost, PC-based systems for performing tasks, such as page layouts and typesetting, writers and editors are becoming increasingly involved in this activity.

Desktop publishing (DTP) systems are interactive design systems for producing printed documents with complex page layouts and typographic specifications. A DTP system provides support for laying out pages; formatting, editing, and importing text; generating, importing, and manipulating graphics; and displaying and printing the formatted document. As the designer composes the document or edits text or graphics, an interactive WYSIWYG display portrays how the final printer output will appear. While originally popularized on the Apple Macintosh, many WYSIWYG desktop publishing systems have recently become available for IBM-compatible PCs. A desktop publishing system requires desktop publishing software, such as Xerox Ventura Publisher (122:--; 182:--) or Aldus PageMaker (77:--), plus extensive hardware, including a high resolution display system (EGA or better), high resolution printer (preferably laser), and typically at least an

AT-class processor with a mouse and hard disk (34:--; 85:--). An optical scanner is frequently included to digitize graphics or text from existing hardcopy (94:--). A number of vendors, such as IBM (164:--) and AST, offer turnkey DTP systems which package all necessary hardware and software. Separate wordprocessing software and graphics programs are also usually required since most text and graphics for the document are imported from external sources.

Page layout typically involves dividing the pages into rectangular frames or columns to hold the text and graphics. Text of the document is then imported from external wordprocessor files and allowed to flow into its designated columns on the page. While not intended for use as a wordprocessor, DTP programs provide limited editing functions for making on-screen changes to the text and adding items such as headers and titles. The desktop publishing system permits the text to be formatted for desired type face, size, position on page, arrangement of columns, section and paragraph style, flow around figures and graphics, widows and orphans, hyphenation, placement of headers and footers, page numbering, and generation of table of contents, etc. The better DTP packages provide considerable automated support for many of these tasks, such as style sheets and automatic hyphenation. Built-in composition tools are normally provided for graphics elements, such as lines, rectangles, and fill patterns used for setting off columns, headings, and figures on the page and for creating line art. Most desktop publishing systems can also import scanned images or graphics files generated by a variety of paint and spreadsheet programs. Graphics can then be scaled, cropped, and aligned to fit within a frame on a page. Printer output can typically be generated for a number of supported printers or in a device-independent page description language, such as PostScript (174:--). Most current DTP packages are limited to handling documents of 100 pages or less. For good discussions of current PC desktop publishing software and hardware, see references 35, 36, and 79.

An alternate approach to preparing documents for publication are non-interactive typesetting and document formatting programs. These types of program preceded development of DTP systems and do not rely on the interactive WYSIWYG display interface of DTP systems. Instead, the user enters typesetting and document formatting instructions with a wordprocessor or editor along with the text of his document. The program then processes these instructions to generate a file containing the formatted document along with appropriate embedded codes needed to drive a specific printer or typesetting system. Many of these programs also have facilities for drawing lines and boxes and for importing graphics files. Examples of this type of product include Fancy Font, PowerText Formatter, and MagnaType (33:--). Also included in

this noninteractive category of typesetting front-ends are the various PC versions of D. Knuth's powerful TEX typesetting program and its various document formatting extensions like LaTEX (6:--; 7:--; 81:--; 171:--). TEX is widely used in technical book publication industry and academia and provides extensive support for typesetting of mathematical equations. PC versions of Unix-style document formatting programs, such as NROFF and TROFF, are also available (169:--). The advantage of such non-WYSIWYG systems is that coding of the file can be done with an ordinary editor or wordprocessor. This permits the document to be prepared on relatively austere PCs or terminals. Frequently it may also be simpler to change a command in a text file rather than revise the format interactively as required in a DTP system. High-end typesetting front ends also tend to offer more typographical controls than current WYSIWYG desktop publishing systems and can produce files compatible with commercial typesetting and publication services. The principal disadvantage of non-interactive approaches is that the effects of typographic and document formatting instructions cannot be seen until the document is printed. This makes such software more appropriate for documents which do not include extensive graphics. Many of these non-interactive programs, however, do provide non-editable preview screens to view the formatted document prior to printing if a graphics display system is available.

Users of current wordprocessors which provide a near WYSIWYG display and support for multicolumn text can integrate bit-mapped graphics with their text without resorting to a DTP system by use of an add-on program like Inset (32:87-88). Inset is a RAM-resident program which can capture, create, or edit graphics screens and then merge them into a document as it is being printed using the wordprocessor's normal print function. To incorporate a screen, the user formats his text with his wordprocessor and leaves a gap for the image in the document. He places the name of the image file in brackets in the upper left corner of this gap and then can activate Inset from within the wordprocessor to display an outline on the screen showing where the image will appear and to rescale the image if necessary. When the image is correctly sized, it can be previewed on the screen. When the document is printed, Inset monitors the output and prints the graphics image in proper size and position, simulating colors with various shades of gray. Inset works with the common IBM graphics adapters (CGA, EGA, Hercules) and supports a variety of printers (IBM, Epson, Okidata and several laser printers) and wordprocessors (e.g., Word, WordPerfect, WordStar, XyWrite). Current versions of MicroPro's WordStar 2000 wordprocessing package include Inset (149:61; 181:--). The graphics integration capabilities provided by an add-on program like Inset are scheduled to be included as built-in features of full-featured wordprocessors like Word and WordPerfect in the near future.

HYPERTEXT SYSTEMS

Conventional documents are designed to be read in a fixed, linear order established by the writer (i.e., from beginning to end except for slight diversions such as footnotes or citations). Similarly, computer-based documents have traditionally been stored as files of characters which are also accessed in a strictly sequential fashion. Such documents are referred to as "linear" or "flat" text.

An emerging computer-based alternative to linear text is nonlinear text or "hypertext", a term coined by Ted Nelson who defined hypertext as "a combination of natural language text with the computer's capacity for interactive branching and dynamic display of a conventional page" (29:17). Hypertext documents differ from conventional documents in that the writer establishes links between various related chunks (objects, nodes) of text (or graphics, sound, etc.) in the computer-readable document database. This organization gives the human reader using a computer many possible paths for reading the hypertext document. The links enable him to follow a specific train of thought from one related idea to another and to control the level of detail and type of information displayed. The information embedded in a hypertext document may be nested to many levels and linked to create a very elaborate web of interrelated information. A simple implementation of hypertext is a document which when displayed on the screen allows the user to select specific highlighted words in the text and to call up more detailed embedded information (e.g., definitions, references, pictures) on the selected item in a separate window. For example, in a hypertext document on astronomy, the reader might arrive at the highlighted word "Copernicus", select the word with the keyboard or mouse, and then be offered a number of related topics from which to choose (e.g., gravity, solar system, history of fifteenth century Poland, etc.) (76:50). After examining this lower material, he might return to his original position in the document and continue reading. An electronic thesaurus is another example of a rather specialized form of a hypertext system of this type. Hypertext appears to be particularly attractive paradigm for training materials, help systems, and reference works. An excellent tutorial on hypertext and survey of current research implementations is provided in reference 29.

Because of their nonlinear organization, hypertext systems require special-purpose software for reading (browsing) and writing (authoring) the document. Current commercially available examples of such software include Guide (47:--; 48:--) and KnowledgePro (18:--; 163:--) for the IBM PC and Guide and HyperCard

(53:--) for the Macintosh (26:--; 128:--). The design of hypertext documents requires the author to develop his written ideas in individual node or objects and then to organize the document by establishing logical links between the nodes.

The principal advantage of nonlinear text is the ability to organize and traverse the document in many different ways. With hypertext documents it is convenient to suspend reading along one line of thought to pursue another trail, to hide detailed information until actually needed by the reader, and to reference the same text segment from many different places. Problems with hypertext include deficiencies in current browsing systems (such as delays in displaying referenced material) and possible disorientation and cognitive overload of a reader who loses track of his position within a complex or poorly structured hypertext document. (29:37-40; 39:70-80)

Hypertext is currently in its infancy but with improvements in processor, storage, display, printer, and on-line database technology, it is likely to become a significant alternative to traditional linear text in the future (107:43). Closely related to the practical exploitation of hypertext is the recent development of CD-ROM systems capable of holding and randomly accessing hundreds of megabytes of data under microprocessor control. This technology makes it feasible to publish very large computer-readable documents (databases) which were not practical or economic with previous storage technology. With further refinements in CD-ROM technology, reductions in cost of CD-ROM players (currently in the $750-1000 range), and the appearance of significant software offerings (like Microsoft Bookshelf), CD-ROMs should become widespread within the next ten years and give a major impetus to publication in CD-ROM format (24:194) and use of hypertext. It now appears reasonable to expect to have a book-size CD-ROM reader/portable computer (akin to Alan Kay's "Dynabook" concept) within that same period as a practical alternative to books in hardcopy form. This device might incorporate a compact CD-ROM reader with digital audio-visual and data playback capability, display screen, microprocessor system, browsing software, and telecommunications support to access libraries and on-line data services. Other computer-based document formats have also been proposed, including "responsive" publications which test the reader for comprehension and adjust the paths through the material accordingly; multi-sensory ("hypermedia") publications which combine sound, moving images, and electronic game techniques with still text and images; and reorganizable documents which automatically regroup material to tailor the document to the specific requirements of the reader (37:256).

Chapter Three

CURRENT WORDPROCESSORS, OUTLINE PROCESSORS AND STYLE CHECKERS

INTRODUCTION

In this chapter we will discuss some current examples of programs from three of the categories of tools introduced in the preceding chapter: wordprocessors, outline processors, and style and grammar checkers. This presentation is intended to give an indication of the capabilities, limitations, and trends in currently available software in these three categories of tools. These three classes represent significant areas of the current CAW tool market from the standpoint of number of sales or available programs and their potential for immediately improving the productivity of writers and editors.

WORDPROCESSORS

Wordprocessors represent the most developed and practical class of CAW tools. With approximately 90% of PCs being used for some amount of wordprocessing and annual sales of wordprocessing packages running in the neighborhood of 500K units, intense competition has produced a large number of highly competent wordprocessing programs (143:73-74). In the following section, we will discuss selected features of several of the leading, full-featured wordprocessing packages: Microsoft Word 4.0, WordPerfect 4.2, WordStar Professional Release 4.0, and XyWrite III Plus (88:--; 146:94-102,344-345; 154:64). Distinctions between these four programs are relatively subtle (147:89). All of these programs provide excellent support for the basic editing functions and include numerous advanced features like spelling checkers and thesauri, mail merge, generation of table of contents and indexes, etc. All require a significant but not unreasonable learning effort to master their many options.

Microsoft Word 4.0 (14:--; 72:--; 136:--; 137:--; 138:--; 146:212-216; 150:--; 168:--), which is the most recent release among the group, is distinguished by its powerful formatting capabilities provided by use of style sheets. A style sheet is a set of specifications of the formats (justification, font, etc.)

of the various paragraphs and headings to be used in a document (4:Ch 13). Each different style of paragraph is described in the style sheet and assigned a unique logical name. In the text of the document, the desired format of each paragraph and heading is designated by attaching one of these names (or default names) to the section of text. When displayed or printed with the style sheet in effect, the document will appear formatted. The advantage of this approach is that format of every paragraph of a given type in a document can be readily changed simply by adjusting the corresponding specification in the style sheet. Version 4.0 adds the capability to create a style sheet from an existing file (so-called style sheets "by example"). Microsoft Word also offers the closest to a WYSIWYG displays of all of the wordprocessors for the IBM PC (147:90). In graphics mode, Word is capable of displaying not only bold and underlined text, but also italics, double underlines, superscripts and subscripts. To speed up display updates, the user may toggle to text mode. Word has a superior built-in outline processor (see below), keyboard macro facility, thesaurus, and adequate spelling checker. It offers numerous additional features including redlining, document summary sheets, box and line drawing, direct import of spreadsheets, and an IBM DCA file conversion utility. Once learned, Word is easy to use, providing multiple ways of editing through use of function keys, mouse, or menus, according to the user's preference (72:68). Microsoft markets an optional utility called Pageview which operates under Windows and provides support for importing charts and graphics into Word documents and for previewing pages (166:--). A new version of Word scheduled for release in late 1988 will integrate desktop publishing capabilities under Windows (70:--).

Both WordPerfect 4.2 (5:--; 139:--; 146:322-326) and WordStar Professional Release 4.0 (3:--; 146:326-328; 148:--) are full-featured wordprocessors of more conventional, text-oriented design. These programs have had the largest number of sales of the major wordprocessing packages--total sales, all versions: 1.0M for WordPerfect (141:141) and 1.5M for WordStar (143:75). They offer many similar advanced features such as spelling checkers and thesauri, math capabilities, macros, mail merge, line and box drawing, headers and footers, generation of table of contents and indices, and extensive printer support. In general, WordPerfect is slightly more capable than WordStar. For example, WordPerfect (unlike WordStar) supports footnotes, sorting, automatic numbering support for generating outlines (see below), automatic hyphenation, automatic paragraph reformatting, multiple editing windows, and very flexible parallel and newspaper style column formats. (Note: WordStar Professional Release 5.0 is slated to add some of these features, including a second document window, footnotes, automatic paragraph reformatting, and additional printer support (98:36).) WordStar, however, does offer interac-

tive WYSIWYG display of justification, while justification can only be viewed on a Print Preview screen using WordPerfect. WordPerfect is heavily function key-oriented, while WordStar uses a combination of control keys, function keys, and menus for entering commands. WordPerfect has an advantage of being hosted on a large number of minicomputers and microcomputers other than the IBM PC. Many add-on programs and third party books are available for WordPerfect (142:24). Because of its well established and very large user base, WordStar has become a quasi-standard. Many programs support WordStar formats and the WordStar command set has been adopted by other developers, notably Borland, Inc. (Sidekick, Turbo Pascal, etc.) and Microsoft, Inc. (QuickBASIC, QuickC). WordStar can be extensively customized via installation and change programs and patching. WordStar is convenient to use for program editing as well as wordprocessing due to its document and nondocument modes of operation. In its next release (Version 5.0, Mar 1988), WordPerfect is scheduled to add desktop publishing features, such as the ability to import a large number of graphics formats and to size, crop, and insert the graphics into a document with text automatically flowing around the images (140:1; 141:141). It will also add a document preview mode, so that users with a graphics display can display two facing pages of the formatted document.

XyWrite III Plus (9:--; 18:--; 146:338-342; 151:--; 152:--; 153:--; 154:--; 183:--) is a powerful text-oriented wordprocessor modeled after the ATEX publishing system used by many newspapers and publishing houses. This program is popular among professional writers and other specialists. It is distinguished by its speed and support for user customization. The program has probably the best spelling checker currently available--it is both extremely quick and offers outstanding correction capability, including automatic replacement of spelling errors and expansion of user assigned abbreviations (99:387). XyWrite III Plus provides excellent formatting and printer support (including laser printers), programming (macro) capability, thesaurus, automatic numbering for paragraphs and outlines, multiple editing windows, mail merge and fill-in forms capability, redlining, support for multiple columns (snaking text), table of contents and index generation, footnotes, running headers and footers, etc. The user has total flexibility to assign functions or character codes to the keyboard via use of keyboard configuration files. XyWrite embeds formatting codes as ASCII text, e.g., <<FL>> denotes "flush left", <<RM70>> denotes position of right margin at column 70. Normally, these codes are hidden (displayed as a triangle on screen) but they can be expanded for viewing and even edited like ordinary text. The display (and all affected paragraphs of the document) are automatically reformatted by the program when a formatting command is changed.

Any of the above programs represents an excellent choice for a full-featured wordprocessor. Retail costs are in the $395-495 range, but they are readily available in the $180-250 range via mail order (146:94). It should be noted that WordPerfect and Word work best with a hard disk since they keep most of the document on disk. WordStar and XyWrite attempt to keep the file being edited in RAM if possible and therefore are less dependent on the disk subsystem for speed (110:225).

There are also many competent wordprocessors available at the lower end of the market, such as PFS: Professional Write (146:274-276; 173:--) and PC-Write 2.71 (83:--; 126:99,101; 146:264-267; 172:--) or as wordprocessing components of integrated software packages, such as Smart 3.1 and Enable 2.0 (40:71; 57:251,256; 97:--). These products generally provide all of the basic editing and wordprocessing features of the leading wordprocessors and usually include advanced features, such as built-in spelling checkers. In selected cases, these wordprocessors may have advantages over leading wordprocessors in such areas as cost, ease of learning, or integration with other applications. However, low-end wordprocessors frequently limit the document size to available RAM and therefore may not be appropriate for editing long documents. They typically lack many of the advanced features of the high-end wordprocessors, particularly in the areas of formatting control and printer support. Moreover, the large number of users, intense competition, and considerable resources of their developers, encourage regular and significant updates of the major wordprocessing packages and support by third party hardware and software developers, as well as writers and publishers of computer books and magazines. These factors, along with the relatively minor difference in cost ($50-150) and high utility of wordprocessing software, justifies selection of standalone full-featured wordprocessors over less capable low-end products or integrated packages in most cases.

Trends in wordprocessing software include increasing emphasis on WYSIWYG (graphics) displays; a merging of word processing and desktop publishing functions (146:254-255), such as the ability to include and manipulate graphics along with text in document and built-in graphics tools for line art and forms; support for laser printers; use of style sheets, standardized high-level markup languages, or similar logical devices for specifying document format and structure; improved user interfaces (pull-down menus, windows, macros, etc.) and help facilities; increased speed; increased and improved functions, including integrated CAW tools (spelling checkers, outline processors, style and grammar checker, file conversion utilities, etc.); increased hardware requirements (memory, graphics, disks, etc.); support for LANs; and support for management of long document. Most of these trends can already be seen in an advanced product like the Interleaf

Publisher document preparation package, which runs on engineering workstations and has recently been rehosted on the Apple Macintosh II (59:--; 60:--). This program combines the functions of a WYSIWYG word processor, graphics package, page layout system, automated document composition system, and long document management system. High cost of the necessary hardware and software is the primary barrier to widespread adoption of such systems for PC word and document processing at the present time. The cost of the necessary hardware, such as high resolution display systems and printer, high-performance processors, high capacity storage systems, is steadily decreasing as the technology becomes more mature and widespread. To accommodate the higher costs and existing installed base of PC systems, a likely compromise for the near term is for wordprocessing programs to be able to operate in either text or graphics modes (like Word 4.0 or WordPerfect 5.0). Developments in systems software, such as Microsoft Windows (131:--; 167:--), offer the potential for significant improvements and standardization in user interface and compatibility among different applications software.

OUTLINE PROCESSORS

Outline processors are available as separate programs and as integrated components of certain wordprocessors and other programs. Outline processors were originally popularized by standalone programs, such as ThinkTank, Ready, and PC-Outline. Recently, outlining features have also started appearing in releases of major wordprocessors (WordPerfect, Word, XyWrite), document processors (Lotus Manuscript), and integrated software packages (Framework II and Symphony 2.0). In this section, we will examine the outline processing capabilities of one standalone program, PC-Outline, and two of the top-rated wordprocessors, WordPerfect and Word, as current examples of this class of tools.

PC-Outline is a standalone outline processor distributed as shareware by SoftWorks Development (registration fee: $49.95). The program supports automatic numbering, renumbering, and indenting of outline entries and the selective hiding/unhiding of lower level entries and text. It provides relatively extensive support for editing, rearranging, formatting, and printing of the outline and can support up to nine outline windows. PC-Outline can operate in standalone or memory-resident modes (requires 80-128K of RAM) and is compatible with ASCII, WordStar, ThinkTank and Ready file formats. PC-Outline is now being bundled with the latest release of WordStar 2000 to provide an outlining capability to purchasers of that wordprocessing package which lacks an integrated outline processor.

PC-Outline (PCO) provides good automated support for its relatively limited task of generating and viewing outlines. However, it suffers from a number of deficiencies, most of which stem from it being a separate program rather than being integrated into a wordprocessor:

1. PCO has a relatively large set of commands (approximately 75 control and function key combinations) for editing, formatting, and collapsing/expanding the outline. The command set is not compatible with any popular wordprocessor. The complexity of the program poses a major learning effort and also probably disqualifies it for occasional use.

2. PCO (and similar standalone outline processors) are not well interfaced to external wordprocessors. Because of the limited word processing functions of most standalone outline processors, it is preferable for the writer to use his regular wordprocessor for composing the text of the document while working from a hard copy of the outline or viewing it in a second window, or after transferring the outline file into the document as ASCII text. Therefore, once the document has been created, subsequent movement or deletion of a heading in the outline will not automatically adjust the corresponding sections of text in the document. With a fully integrated outline processor like the one included in Microsoft Word (discussed below), however, it is possible to move, copy, or delete all affected sections of a document simply by editing the headings in the outline.

3. Unless operated in memory-resident mode, the user must exit or suspend his wordprocessor to run PCO to access his outline. This is inconvenient. It may not always be possible to operate in memory-resident mode due to memory constraints or incompatibilities with the wordprocessor.

4. PCO does not adequately support outline headings which are greater than one line. Everything beyond the first line of an entry is simply regarded as text and becomes hidden when display of text is suppressed.

Because of the limited function that PC-Outline performs and the deficiencies noted above, we do not recommend use of the program, except for someone who has a frequent requirement for creating outlines. The occasional user is probably better off using his wordprocessor to create the outline as a regular document or to use paper and pencil. These alternatives, of course, do not provide the support for collapsing/expanding or reorganizing the outline that PC-Outline provides. Another alternative is to use a wordprocessor which features an integrated outline processor. Integrated outliners are generally easier to learn and have the potential for increased functionality.

The outlining capability included in WordPerfect 4.2 is minimal, being little more than an extension of its basic automatic paragraph numbering feature. It supports automatic numbering and renumbering of entries in an outline but not collapsing or expanding the outline. In outline (versus normal editing) mode, the function of the tab key is altered so that a tab character at the beginning of the line causes WordPerfect to automatically indent and generate the number for the next entry in the outline. An additional tab character will indent the number to the next tab position and convert it to the next lower level. Deleting a tab character will cause the number to be raised one level. In outline mode, insertions and deletions of entries automatically renumber all affected entries in the outline. WordPerfect supports three built-in numbering styles which can have a maximum of seven levels as shown below:

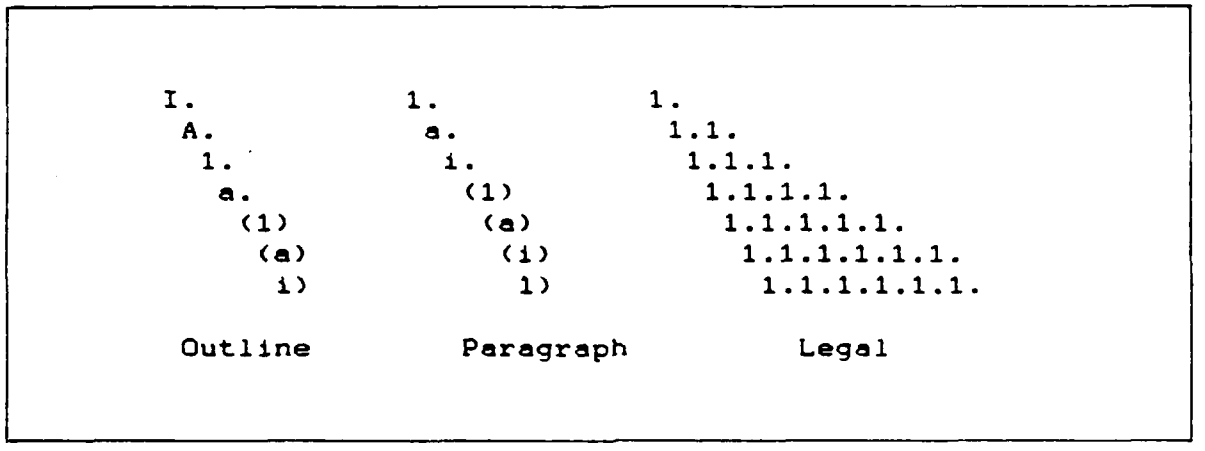

Figure. 1. WordPerfect's Numbering Styles for Outlines

Other numbering styles can be defined by the user via WordPerfect's paragraph numbering definition screen. In summary, the outlining feature in WordPerfect is simple to use, but does nothing more than automatically number the entries in the outline.

In contrast to the WordPerfect, the outline processor in Microsoft Word is quite powerful and useful. It provides for the usual automatic numbering and renumbering of headings as well as for expanding and collapsing outline headings and text. Moreover, it provides significant document processing capabilities since it permits quick restructuring of the entire document by simply manipulating the outline and extensive formatting of head-

ings in the printed document through use of Word's style sheets. Word has two modes for viewing a document, document mode and outline mode. Outline headings can only be created in outline mode. (Text of the document can be entered in either mode.) Outline mode also supports collapsing and expanding headings and text and raising or lowering the level of a heading, while document mode always displays fully expanded headings and text. Changes can be made in the outline structure (and hence structure of the document) by shifting to the outline mode and activating the outline edit function. This alters the function of the left and right arrow keys to cause Word to jump from one heading to the next, regardless of its level, while the up and down arrows are used to jump to the next heading with the same level. By collapsing the outline to hide text and lower level headings, the user can move around a large document very quickly. In outline edit mode, deleting, inserting, and copying operate on an entire heading and all subordinate headings and text. Thus it is a simple matter to reorganize a document to move an entire chapter by simply moving the heading for the chapter. Since Word supports windows, the user can maintain an outline view of a document (with subordinate headings and text collapsed) in one window and a document view in another window which shows full text and headings. Changes made in one window are automatically reflected in the other. Using the outline feature in combination with Word's style sheets, allows the user to format each heading level for typeface, justification, etc. The outline headings will then become formatted headings in the document when it is displayed or printed with the style sheet in effect. Use of numbers for outline headings is optional. The outline headings can be automatically numbered and renumbered using Word's Library Number command. To use the outlining feature of Word, it is necessary for the user to learn about a dozen additional key sequences. Because of its high level of integration with the underlying wordprocessor, Word's outline processor provides significant document processing capabilities (e.g., ability to reorganize document) in addition to its more mundane use as a outline generator. This level of functionality is probably only possible in an integrated (versus standalone) outliner processor. The outline processor of the type incorporated in Word represents a very useful tool to the writer-editor and a model to be adopted in other word and document processors.

Another promising extension of the function of outlines is to use them to specify the format of the sections of a document. Under this scheme (known as "structure-oriented editing" or "outlining with descriptive markup"), each heading of the outline is tagged with a descriptive label to an entry in a style sheet which specifies the format of the corresponding section of the document (30:945). Both format and structure of the underlying document could then be modified simply by editing the outline.

STYLE CHECKERS

Style and grammar checkers available for the PC include the following: PC-Style, RightWriter, Grammatik II, Punctuation and Style, Electric Webster, and PC-Read. A review of the first five programs can be found in reference 90. (The last program, PC-Read, is a shareware program whose only function is to compute an simplified reading grade level index for a text file or selected part thereof.) In the following paragraphs we will briefly discuss PC-Style and RightWriter, both of which we personally evaluated in the course of preparing this report.

PC-Style is a very simple style checker which is marketed by Buttonware, Inc. as shareware (registration fee: $29.95). The basic premise of this program is that effective writing requires short sentences, many "action" verbs, and use of personal pronouns. The program scans an ASCII or WordStar-compatible document file and displays (or prints) a simple 15-line report providing the following statistics:

- Number of sentences
- Number of words
- Words per sentence
- Percentage of long words
- Percentage of personal words
- Percentage of action verbs
- Average syllables per word
- Readability (grade level) index

A sample document and corresponding PC-Style report are provided in Figures 2 and 3. The report lists numerical values for each variable in a table and then plots each value on a scale showing the allowable range from poor to best. It also displays overall ratings of readability, personal tone, and action on scales of poor to excellent. The user can modify the ranges of the scales and add or delete words from the dictionary of action and personal words by editing a profile (.PRO) file. The program does not actually proofread the document to identify and locate specific errors.

Because of the simplistic premise of PC-Style and its failure to proofread the document, this program is little practical value. Raskin noted that PC-Style regularly reported higher readability scores than other style checkers, raising questions about the validity of the algorithm used by the program (90:14-15). We observed that PC-Style had difficulty in determining the number and length of sentences in a document, an important factor in many readability formulas (see example in Figure 3). The use-

fulness of such formulas for measuring reading difficulty or style is dubious, especially for analysis of documents intended for sophisticated or specialized audiences (92:--).

RightWriter by Rightsoft, Inc. (retail price: $95) is a more ambitious program than PC-Style (8:--; 90:12-14; 102:--; 177:--). It proofreads a document file and produces a marked-up copy with comments pointing out possible errors in grammar, style, usage, and punctuation. RightWriter analyzes the document by comparing the text against a set of grammar, syntax and word usage rules and a 45,000 word dictionary used for detecting misspellings, jargon, slang, etc. RightWriter uses a list of 44 different comments which it can insert at points in the document where it detects a potential problem. These comments include suggestions for replacing a phrase with another phrase and for correcting problems with punctuation, long or incomplete sentences, use of passive voice, split infinitives, etc. At the end of the marked-up copy, RightWriter includes overall critique of the document. This summary contains the following components (8:Ch 5):

- Reading grade level: Overall reading grade level computed using Flesch-Kincaid method as specified in MIL-M-38784B.

- Strength index: Strong writing uses active voice and avoids use of unnecessary qualifiers, uncommon words, and complex sentence structure.

- Descriptive index: Use of too many modifiers (adjectives and adverbs) makes writing wordy and difficult to under stand.

- Jargon index: Measures use of jargon or buzz words.

- Sentence structure: RightWriter detects repeated patterns, such as most sentences containing multiple clauses or start ing with a particular part of speech.

The summary also includes general recommendations for improvement in the above areas as appropriate. It concludes with a list of words to review, including possible misspelled or misused words plus jargon, slang, and obscure words. Figure 4 is an example of RightWriter's analysis of the document of Figure 2.

RightWriter is simple to use. To check a document file EXAMPLE.DOC, the user enters the command RIGHT EXAMPLE.DOC at the MS-DOS prompt. RightWriter then analyzes the document and generates a marked-up copy in a file named EXAMPLE.OUT. It takes RightWriter about two minutes to analyze a three page, double-spaced paper (approximately 900 words). The process proceeds in two phases, generation of a dictionary for the document and

sentence structure analysis. No operator intervention is required while RightWriter analyzes the document. RightWriter is fully compatible with a large number of wordprocessors, including WordStar, WordPerfect, XyWrite, PFS: Professional Write and PC-Write. This means that a document file can be read directly by RightWriter and that the marked-up copy produced by RightWriter can be edited with the original wordprocessor. After revising the marked-up copy as he sees fit, the writer may use the remove option of RightWriter to strip all by RightWriter comments from the final document. (Alternatively, the user can edit the original file by referring to a printed copy of the marked-up file or by placing the marked-up copy in a second window.)

The RightWriter manual advises the user to regard RightWriter's comments and recommendations as advisory rather than authoritative when deciding how to revise the document (8:viii). The manual acknowledges that RightWriter may flag as improper certain constructs which may be appropriate in a particular document. For example, RightWriter will flag all occurrences of passive voice and all sentences of more than 22 words in length as potential problems. The manual states that the program has no knowledge of semantics or exercise of literary license. Furthermore, the user cannot adjust or augment the rules used by the program. To add words to RightWriter's dictionary, it is necessary to purchase an optional utility called RightWord (retail price: $29.95), a feature which is included in other analyzers such as Punctuation and Style.

Our experience in using RightWriter to analyze documents (including several ACSC student writing assignments) was mixed. RightWriter does a laudable job in certain tasks such as detecting use of passive voice or wordy phrases. However, we found that most of the comments and recommendations made by RightWriter about our test documents were erroneous or inappropriate. The vast majority of the comments made by RightWriter concerned long and complex sentences which were in fact appropriate in the professional communications being reviewed. (RightWriter considers any sentence with more than 22 words as too long.) The frequency of these comments was so great as to be irritating. Other errors in RightWriter's analysis were noted, including problems in determining where sentences ended (probably due to confusion with punctuation) and inability to handle instances where parsing was necessary to analyze the situation (e.g., the program flagged the phrase "to many black Americans" as a split infinitive and suggested that the word "that" be replaced with "who" in sentences like "He told his men that the job was done."). The extremely high incidence of false alarms along with a low incidence of useful comments eventually caused us to discontinue use of the program. Raskin noted that programs like RightWriter seem to flag only about 25 percent of the mistakes in a document

that a human editor would catch, e.g., none of the five programs he reviewed could detect errors in tense or person (90:10). We consider RightWriter in its current form (and similar programs) to be of little practical value to the experienced writer. The program may be of limited use to inexperienced writers (including those using English as a second language) who are more apt to make the types of obvious errors that the program does detect reasonably well, e.g., sloppy punctuation, poor word usage, passive voice, etc.

Programs like RightWriter are evolving. For example, the latest release of RightWriter added 800 rules (3000 total) and 12 new classes of rules. Performance of these programs probably can be improved substantially by expansion of their rule sets and phrase dictionaries and by use of techniques such as sentence parsing to analyze errors in context. When their performance does increase to the point where style and grammar checkers are of practical value to the average user, we predict that style and grammar checkers will be incorporated in word and document processors like spelling checkers, thesauri, and outline processors have already been. Even then, however, the author or editor will still need to review the document for the non-mechanical aspects of writing, such as content and organization.

The current status of dealer sales is terrible. Our traditional dealer sales strategy does not seem to be working. Current sales figures seem to be indicative of a major problem. In view of the fact that the entire company's future depends on dealer sales, this problem must be acted upon expeditiously to develop a multiplicity of solutions to overcome the problem (e.g. better point of sale material, more market research, more support by reps, etc.

Figure 2. Text of Example Document (8:3-1)

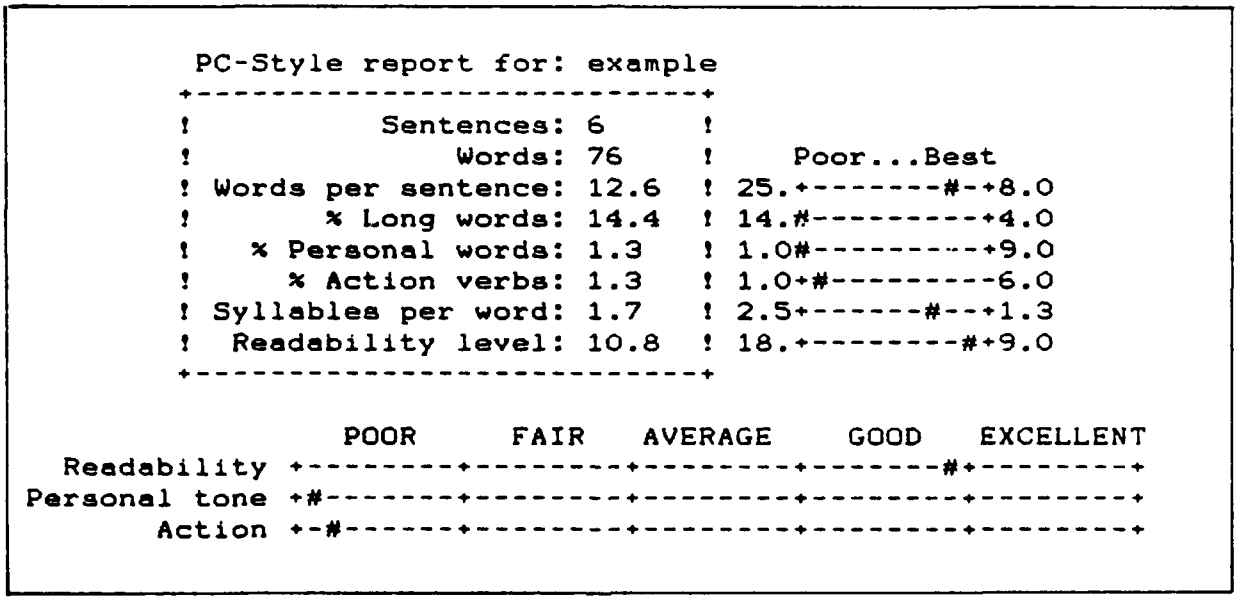

Figure 3. Analysis of Example Document by PC-Style

(Note: Number of sentences is incorrect.)

```
The current status of dealer sales is terrible. Our traditional
     <<* 13. REDUNDANT. REPLACE current status BY status *>>
dealer sales strategy does not seem to be working. Current sales
    <<* 11. AMBIGUOUS?: traditional dealer sales strategy *>>
figures seem to be indicative of a major problem.  In view of the
  <<* 44. USE VERB FORM. REPLACE be indicative BY indicate *>>
fact that the entire company's future depends on dealer sales,
   <<* 2. WORDY. REPLACE In view of the fact that BY since *>>
this problem must be acted upon expeditiously to develop a
                          ^<<* 21. PASSIVE VOICE: be acted *>>
      <<* 7. REPLACE expeditiously BY SIMPLER quickly *>>
multiplicity of solutions to overcome the problem (e.g. better
                <<* 33. PARENTHESIS NOT CLOSED *>>^
point of sale material, more market research, more support by
reps, etc.
          ^<<* 31. COMPLEX SENTENCE *>>
          ^<<* 39. CAN SIMPLER TERMS BE USED? *>>
          ^<<* 17. LONG SENTENCE: 45 WORDS *>>

                        <<** SUMMARY **>>
    OVERALL CRITIQUE FOR: example

    READABILITY INDEX: 11.39
Readers need an 11th grade level of education to understand.
      Total Number of Words in Document:  75
      Total Number of Words within Sentences:  75
      Total Number of Sentences:   4
      Total Number of Syllables: 125
    STRENGTH INDEX: 0.00
The writing can be made more direct by using:
                      - the active voice
                      - shorter sentences
    DESCRIPTIVE INDEX: 0.61
The use of adjectives and adverbs is within the normal range.
    JARGON INDEX: 0.42
The writing contains a good deal of jargon.

 SENTENCE STRUCTURE RECOMMENDATIONS:
             14. Consider using more predicate verbs.

                        << WORDS TO REVIEW >>
   Review the following list for negative words (N), colloquial
   words (C), jargon (J), misspellings (?), misused words (?),
   or words which your reader may not understand (?).
 EXPEDITIOUSLY(J)  1      INDICATIVE(?)  1    MULTIPLICITY(J)  1
          REPS(?)  1        TERRIBLE(N)  1
```

Figure 4. Analysis of Example Document by RightWriter

Chapter Four

CONSIDERATIONS IN SELECTING CAW TOOLS

INTRODUCTION

The general factors which need to be considered in selecting CAW tools are basically the same ones which should be addressed in choosing any applications program. These factors include function and performance, system requirements, cost, training, and compatibility. As previously noted, certain classes of CAW tools are so immature that no suitable products are currently available.

FUNCTION AND PERFORMANCE

The functions and level of performance provided by a CAW tool or other software product can be assessed in a number of ways. These methods include hands-on evaluation, advice and experience of other users, reviews and articles appearing in computer magazines and other periodicals, study of manuals and books on the program, and product announcements and advertisements. The program should satisfy and preferably exceed the immediate and projected requirements of the user. In addition to implementing the necessary functions, the program should provide acceptable levels of performance in such areas as speed, ease of learning, ease of use, and error handling. Where possible, a program should be evaluated by comparing it with a number of the best or most popular tools available for the particular task. Such comparisons serve not only to highlight strengths and weaknesses of the product but also to establish a reference for what constitutes a good level of function and performance. Special care should be observed in selecting new programs or software from immature classes of tools since the likelihood of defects, overstatement of capabilities, and other problems is high in such cases. Quality of supplied documentation and tutorials, availability of third party programs and publications, product reliability, and reputation of the developer are also important considerations. Because of the very competitive nature of the PC market, the popularity (number of sales and users) is a fairly reliable indicator of utility for established products. The above factors tend to favor the selection of the most popular,

full-featured programs in their categories, e.g., WordPerfect or Microsoft Word for wordprocessing packages and Ventura Publisher or Aldus PageMaker for desktop publishing software.

SYSTEM REQUIREMENTS

System requirements are the hardware and software which must be available on a PC to run a particular applications program. System requirements are normally specified in terms of required machine type, minimum amount of main memory (RAM), number and type of disk drives, type of display system, printer, mouse or other special input/output devices, and DOS version. Requirements may also include the amount of disk apace required for installing and running the program and, for LAN-based software, necessary LAN hardware and software. For example, system requirements for the XyWrite III Plus wordprocessing package are an IBM or compatible computer, 384K bytes or more of main memory, IBM PC-DOS 2.0 or higher, monochrome or graphics (CGA or EGA) adapter with 80-column display, one floppy disk, and a supported printer. Desktop publishing systems in particular have large system requirements, normally including a high resolution display, high speed processor, full complement of memory, mouse, and laser printer.

The presence of the minimum system hardware and software, however, does not guarantee convenient operation or fast execution of a program. Frequently an additional floppy disk drive or hard drive may be needed to avoid excessive disk swapping. An optional mouse may in fact be essential for convenient or precise operation of graphics-oriented software. Certain programs may run unacceptably slowly on machines without hard drives or full complements of memory or on systems with low performance processors, such as an 8088-based PC running at 4.77 MHz. Execution speed can often be improved by loading files into RAM where available. Text-only systems are limited in their ability to achieve WYSIWYG displays and cannot support programs or features which require graphics. On the other hand, graphics-oriented programs require more costly hardware support and typically run more slowly than text-only programs. Low resolution display systems, such as IBM CGA, tend to produce text displays which appear fuzzy and graphics displays which may lack sufficient detail or smoothness.

System requirements for wordprocessors and other applications have steadily increased, particularly in the amounts of memory and disk space needed to hold program and data files. As more programs incorporate graphics or make use of graphics environments, the desirability of having higher performance graphics systems (EGA or better) and processors (80286 or better) and a

mouse will also grow. Higher print quality and resolution, speed, compatibility with page description languages and applications software, and declining prices favor use of laser or similar types of printers for final copy. This growth in system requirements is being accelerated by simultaneous developments in other areas, such as graphics, database, and spreadsheet applications and system software like Windows and OS/2. Substantial growth of requirements for CD-ROMs and communications networks can also be expected.

TRAINING REQUIREMENTS

Complex programs for the PC, such as full-featured wordprocessors and desktop publishing system, require a significant learning effort because of their large number of often cryptic commands and the lack of standardized user interface for PC systems. This learning effort can generate substantial resistance to adoption of a new program unless it provides substantial improvements in performance or function. Commands are usually entered by use of function keys or double or triple key combinations (shift, ctrl, shift-ctrl, etc.), menus, or separate command lines. Substantial memorization and practice is required for mastery. To assist in this process, many programs offer several command interfaces, e.g., a menu system for the novice and a quick key approach for experts. These interfaces are usually supplemented with disk-based tutorials for new users and on-line help facilities. While most users are generally self-taught (73:--), informal assistance of other users who are already familiar with the program, training and reference manuals supplied with the program, books on the program by third parties, formal training, and technical assistance from the developer via telephone can also assist the new user in becoming proficient in use of the program. A helpful approach to learning such programs is first to master the basic operations needed to produce simple documents and then gradually expand to more complex operations. Regular use of the program is required to ingrain this knowledge. In general, however, ease of learning is a secondary consideration to other factors, such as ease of use, functions, speed, etc. Standardization of user interfaces, such as widespread adoption of the Microsoft Windows or the OS/2 presentation manager, should simplify learning in the future. Adoption of a popular program will increase the probability that personnel are already familiar with the software from prior personal or work experience, thus reducing organizational training requirements.

STANDARDIZATION AND COMPATIBILITY ISSUES

Standardization of hardware and common applications software within an organization can greatly simplify system management, training, support, and compatibility. Industry-wide hardware and software standards promote compatibility and the larger market bases which encourage competition among vendors and development of new products. When adopting a standard for an organization, such as a particular machine configuration or wordprocessor package, extreme care should be taken in selecting the product to assure that it will meet the organizations current and future requirements. Selection of a product which does not meet requirements or is not kept competitive by its developer can have serious consequences on user productivity or acceptance and follow-on support. Replacement of standard at some later date may be difficult because of the number of people affected, costs, and conversion and retraining effort involved. Unnecessary standards or standards which overly restrict productivity or creativity should be avoided. In many cases, it may be preferable to support several programs for a given task or to specify standards at the level of data interchange or user interface rather than requiring use of a specific proprietary product. (21:58)

The large number of users of the most popular application programs makes them quasi-standards and encourages the support of these programs by third party developers and authors of computer books. For example, a developer of an add-on program which works with wordprocessors is much more likely to support WordPerfect, Word, and WordStar than less popular wordprocessors. Numerous reference books and magazine articles are also published for the most popular packages. Assistance from other users, previous user experience, and compatibility with other organizations are also more likely with such programs.

Most CAW tools must be able to import files from other sources. For example, a writer may wish to import a file in ASCII or another wordprocessor format into his wordprocessor. Desktop publishing system import most of their text and graphics from external wordprocessors and graphics programs. A style analyzer needs to read document files. Therefore care must be exercised in selecting various programs to assure compatibility of files. Most programs requiring text files as input are able to accept files in ASCII format. This is less desirable than being able to import the foreign wordprocessor format directly since it requires an extra operation to convert the file to ASCII format and generally results in loss of formatting instructions. Loss of formatting instructions is not a problem with programs like style checkers which are concerned solely with the text of the document but is a significant inconvenience with wordprocessors and desktop publishing packages where document formatting is sig-

nificant. Most CAW tools are able to import or export text files in a limited number of wordprocessor file formats. Standalone utilities are also available for converting between various wordprocessing formats. Formats which are most commonly supported include ASCII, IBM DCA (Revisable Form), WordStar, and to a lesser extent WordPerfect, Word, XyWrite, and MultiMate formats (146:182-187). Similar problems arise when importing spreadsheet data and graphics into programs. Desktop publishing systems and document processing packages can generally import graphics files from a variety of paint, CAD, and other graphics programs. Problems with file compatibility can be minimized by adopting the most popular, high-end applications software which typically have the most widespread support, by standardizing common applications packages throughout an organization, by use of applications from a single vendor or for a specific environment, and by use of integrated software packages.

It is common to run add-on CAW tools, such as spelling checkers, thesauri, and outline processors, as memory-resident programs. Memory-resident keyboard enhancement utilities (89:--, 119:--), such as SuperKey or ProKey, and desktop organizers (117:--), such as Sidekick and Metro, are frequently used in conjunction with wordprocessors. Memory-resident programs have the potential for causing conflicts with other applications, such as wordprocessors, and should be reviewed for compatibility before adoption. Note that many potential problems are eliminated by use of full-featured products which include these features as built-in functions.

The system requirements for running software must be checked to see that they are compatible with the system (both hardware and system-level software) the program will be installed on. If not, the system must be augmented or another product selected.

The introduction of new technology can increase the potential for incompatibilities to arise. After several years of relative stability and standardization with the IBM PC, XT, and AT series of machines, the PC market is in a state of flux because of the introduction of the IBM PS/2 series with its new Micro Channel Architecture (MCA) and Video Graphics Array (VGA) display system, proliferation of 3.5-inch floppy disk drives and various high resolution graphics formats, lack of standardization for 32-bit busses, competing operating systems, and hardware-dependent systems software, such as OS/2 and Microsoft Windows (55:--; 56:--; 71:--; 106:--; 111:--; 114:--; 123:--; 124:--; 125:--; 131:--; 132:--). A very common compatibility problem is the need to transfer program and data files between 3.5 and 5.25-inch floppy disks. This task can be accomplished on a single system which has both types of drives or by transferring files between two systems using a data transfer facility specially designed for

this purpose, a conventional RS-232 data communications link via modem or direct connect, or a LAN (44:--; 91:--). PC software is now commonly available in 5.25 and 3.5-inch formats and therefore it may be necessary to specify the desired disk format.

COST, UPDATING, AND LICENSING ISSUES

The retail cost of popular, high-end wordprocessors is typically in range of $395-495. These programs, however, are readily available through mail order at roughly half the retail price (146:94; 110:228-245). Low-end wordprocessors are normally priced in the neighborhood of $100. Given this relatively small cost difference, we favor the purchase of one of the popular, full-featured wordprocessors, such as Microsoft Word or WordPerfect. High-end desktop publishing software, such as Ventura Publisher and Aldus PageMaker, are available at discount for approximately $500. Other standalone CAW tools vary in price (with $100 being typical) and are also normally available at a discount via mail order.

It is common practice of software developers to update their products to incorporate fixes and enhancements. The update policy of the developer should be reviewed to assure the availability of regular updates at a reasonable price. If the purchaser expects to require technical support from the developer (e.g., by telephone, newsletter), the cost, availability, and quality of such support should be assessed.

Some developers offer site licenses for their products which allow for installation of a program on a number of machines. These licenses, however, can vary greatly in terms of cost per installation, restrictions on number of machines or personal use, rights to local duplication of documentation, etc. Often special discounts or site licensing arrangements are available to educational or governmental organizations. In many cases it may be desirable that employees be permitted to install the programs on their personal machines so they may train or work at home. An example of such an arrangement is the site licensing agreement for the PC-TEX typesetting program at the Air Force Institute of Technology School of Engineering which permits students to install the program on their home machines.

PLANNING ISSUES

Funding considerations and other long-lead items (e.g., facilities, personnel, etc.) dictate that requirements for computer resources be identified well in advance. Requirements for computer resources should be documented in plans which are

reviewed and updated on a recurring basis. Plans must be based on well-justified user requirements as well as technological and economic feasibility. They should explain and justify the requirement and identify necessary hardware and software, manpower, training, installation and facilities modifications, cost and schedule, and OPRs. Requirements for recurring hardware maintenance, periodic upgrades of hardware and software, system administration and support, and special supplies should also be identified in the plan.

When making hardware or software acquisitions, it is advisable to try to project long term requirements and technological trends in order to minimize future obsolescence and incompatibilities. Technological trends can be discerned by examining systems being developed for research or for the high end of the market and by reviewing academic, technical and trade publications for new developments and product announcements. (28:--; 74:--; 110:--; 116:--) For example, the obvious trend toward increased memory and processor requirements for most applications software and likely migration of operating systems for IBM-compatible PC's away from DOS towards Windows, OS/2, Unix derivatives, etc. now mitigate against purchase of 8088/8086-based PC's and 80286-based systems to a lesser extent for long term use. The trend toward use of high resolution, bit-mapped graphics in many applications (e.g., desktop publishing, WYSIWYG wordprocessors, graphics software) and in user interfaces (e.g., windowing systems) make purchase of the text-only or low resolution graphics display systems like IBM CGA and daisy wheel and most dot matrix printers also unattractive. Consideration should be given in selecting hardware and software to its compatibility with LANs and other operating systems if future installation of a network or migration to another class of computers or operating system is envisioned. When planning for a LAN, the increased workload on systems personnel for centralized tasks such as network management and maintenance should be addressed. When selecting a product, an attempt should be made to assess the responsiveness and long-term viability of the manufacturer or vendor in order to assure future availability of technical support and regular upgrades of the product.

Chapter Five

APPLICATION OF CAW TOOLS AT ACSC

BACKGROUND

The computer environment of the Air Command and Staff College consists of approximately 120 standalone Zenith Z-100 and Z-158 computer systems installed in faculty and staff offices and student seminar rooms. The systems are used primarily for wordprocessing, database applications, and slide preparation and presentation. The Z-158 systems are IBM-compatible machines with CGA display systems, while the Z-100 systems have been retrofitted to emulate CGA graphics and to run IBM-compatible software. Printers attached to these systems are of the dot matrix or daisywheel variety. A computer room with five Z-158 and one Z-100 system has been set up to support training and to provide a central facility for specialized equipment such as plotters. The set of standard software used throughout the organization includes MS-DOS 3.1, Smart Software System 3.1 integrated software package, and Show Partner graphics presentation package. The Smart system contains wordprocessing, database, communications, spreadsheet (with graphics), and time management/calendar modules. Current standardized CAW tools are limited to the Smart wordprocessor and evaluation copies of the PC-Style and PC-Read style checkers. To assist researchers and supplement its collection, the Air University (AU) Library offers on-line searches of a number of DOD-supported and commercial databases (e.g., Dialog, Nexis) (157:2). It also provides dial-in access to its computerized card catalog system. Access to the Defense Data Network is possible via a terminal access controller (TAC) located at Gunter AFS.

The ACSC curriculum includes instruction in staff communications and requires the preparation of a research paper and various writing assignments. Use of wordprocessors and other CAW tools for preparing writing assignments is optional. Each seminar room is equipped with one Z-158 system on loan to the school from the Air Force Wargaming Center for use by the thirteen students assigned to the seminar. These systems include 640K RAM, CGA display system, two 5.25-inch floppy drives, a dot matrix printer, and a 10 Mbyte (removable) Bernoulli drive. These systems are available to students for wordprocessing (using Smart)

and preparation and presentation of charts and graphics (using PC Paintbrush and Show Partner), but usage is low. A course on using the Smart wordprocessor is offered as an elective to ACSC students. Many ACSC students have home systems for wordprocessing and other applications. Interest in wordprocessors and other aids for writing and publishing, such as style checkers and graphics programs, is high among students. When they do use seminar room systems, these students often bring in their own software on floppy disks rather than using the standard software installed on these systems. Legal restrictions and school policy which preclude the copying of software between school and personal systems further complicate this situation.

Previous research indicates that ACSC students have difficulty in a number of areas of writing, including organization, expression, and grammar (160:Ch 4). While current CAW tools do not address the area of organization (except for help in producing an outline), they do provide some assistance in the areas of expression and grammar. For example, the better spelling checkers do an excellent job in eliminating most spelling errors. Style checkers like RightWriter attempt to address common problems such as poor word usage, lack of variety of sentence structure, use of passive voice, and punctuation with mixed results. The ACSC grading process places considerable weight on mechanical errors in writing and therefore CAW tools aimed at proofreading have definite applicability (156:102-103).

ASSESSMENT

The PC systems installed at ACSC are low performance systems, using the relatively slow Intel 8088 microprocessor and low resolution CGA display system. While such systems provide adequate performance for most current applications, they tend to lack the processor power or display resolution needed for more demanding software, particularly graphics-oriented programs such as Microsoft Windows or Word and Aldus PageMaker. This problem is likely to become more common as programs grow in size and complexity and make use of higher resolution graphics interfaces. The Z-100 systems are not compatible with IBM hardware standards and hence cannot use the many boards and peripherals available for the IBM PC. The dot matrix and daisywheel printers used on these systems suffer from relatively low print quality, flexibility, and speed when compared to more advanced technologies, such as laser printers. The relatively slow or low capacity disk drives (e.g., 5.25-inch floppies or Bernoulli drives) on these systems pose problems for disk-intensive software and handling of large documents or databases. The lack of any networking of the systems makes it difficult to share expensive resources, such as laser printers or mass storage. Faculty and staff make extensive

use of their PC's, particularly for wordprocessing and document preparation. Machines in the student seminar rooms, however, have relatively low use rates. This is due to a number of factors: student schedules, high incidence of ownership of personal systems by students, preference for working at home, limited selection of software available on the seminar room systems, effort required to learn software such as Smart, incompatibility of school and home systems, lack of integration of these systems in the curriculum, and problems with building access after duty hours.

The Smart wordprocessor (13:--; 97:--) has been adopted as the standard wordprocessing program for PC systems at ACSC. This program is a competent, mid-range wordprocessor which offers a number of advanced features, including LAN support, automatic reformatting of paragraphs, multiple windows and fonts, RAM-based spelling checker, footnotes, insertion of graphs (from Smart spreadsheet), macros, and ASCII, WordStar, and DCA format conversion. It also offers the advantage of being integrated with other components of the Smart system, such as the Smart spreadsheet/graphics module. Unlike some of the full-featured wordprocessors, however, it lacks a thesaurus, outline processor, style sheets, and support for generation of indexes and tables of contents. It also provides rather limited hardware support, e.g., restricted use of EGA and relatively small number of supported printers (12:5). Because Smart is a high-end integrated software system aimed at the corporate market, few students or new staff are likely to have prior experience with the package or use the system on their personal machines. Smart's native file formats are not widely supported by other programs, including add-on CAW programs. Finally, like other integrated packages, the individual components tend to be less capable than the best standalone wordprocessors, databases, spreadsheets, etc. This is of particular concern from the standpoint of CAW since full-featured wordprocessors are steadily incorporating CAW tools and other enhancements as standard features and thus increasing the potential for programs like the Smart wordprocessor to lag farther behind. The available style checkers, PC-Read and PC-Style, are of little practical use (see Chapter 3). Despite the large amount of documents that are published as course materials and research reports, no desktop publishing systems or other aids are available for use by the faculty, staff or students.

RECOMMENDATIONS

1. Priority for improving computer support should go to systems used by the faculty and staff, with particular emphasis on facilities for document preparation and publishing and for networking. Because of the large number of students at ACSC, the cost of providing a high level of support to each student is cost-prohibitive. (Hypothetical examples of a high level of support are providing each student access to a desktop publishing system or document preparation system with a laser printer to prepare and print research reports, presentation materials, etc. or furnishing each student with a computer system on loan for use at home for the duration of the course.) Requirements for computer support for students should be maintained at a sufficiently low level that they can be satisfied by reliance on use of students' personal machines and software, existing seminar room computer systems, and limited use of other facilities, such as the ACSC computer room. No immediate addition of CAW tools for student use in the curriculum is recommended.

2. When selecting CAW software, such as proofreaders and formatting programs, for future use at ACSC, consider compatibility of the software with wordprocessing programs commonly used on home systems of faculty, staff, and students. Even if software cannot be copied for use at home, such compatibility will permit users to bring edited files from home. The ability to work at home is a convenience to the user and reduces organizational hardware and software requirements and costs.

3. When feasible and appropriate, commercial software should be acquired under site licenses which permit installation of the software on home machines of faculty and students.

4. Establish an OPR to monitor and evaluate developments in CAW tools identified in Chapter 2 and related computer technology for possible use by faculty, staff, and students. (The sources referenced in this report are useful for accomplishing this task.)

5. Maintain a list of recommended CAW tools and other software with data on capabilities, compatibility, availability, etc. and encourage participation of faculty, staff, and students in this process.

6. Maintain a library of public domain and shareware software. site licensed software, and evaluation copies of commercial software for copying by students, faculty, and staff.

7. Equip at least one system in the ACSC computer room with both 3.5-inch and 5.25-inch drives to support transfer of data files between different formats.

8. Install a wordprocessing file format conversion utility, such as Word-For-Word (135:--; 179:--), on the above system.

9. Encourage students to submit copies of their research papers in computer-readable format. Establish standards and prepare instructions for this task.

10. Eliminate the unnecessary use of preprinted forms which are not compatible with wordprocessors. (Examples are the various forms and title and heading sheets required for the research project proposal and paper.)

11. Start planning for replacement of Z-100 systems. (Because these machines are not IBM-compatible at the hardware level and have been discontinued by the manufacturer, these systems offer little potential for future hardware upgrades and increasing prospects of maintenance and compatibility problems.)

12. Investigate feasibility of upgrading existing Z-158 systems with 80286 or 80386 speed-up or mother boards and EGA or VGA display systems to handle future software requiring increased processor speed and higher resolution graphics. (Note: 80286 speed-up boards for PC's are now available for under $300.; 80386 boards are available in the $1000 range.) (49:--; 58:--; 69:--; 101:--; 109:--; 115:--; 118:--; 120:--; 121:--)

13. Start procuring laser printers as replacements for existing daisywheel printers. Laser printers offer tremendous improvements in speed, noise level, and typographic quality and are required for making full use of capabilities now provided in desktop publishing systems, add-on typographic programs, and wordprocessors with extended laser printer support (17:--; 62:--; 63:--; 104:152-243). These laser printers can be used for final copy, while existing dot matrix printers serve as draft or local printers. Ideally these printers should be installed on a server on a network for widespread accessibility. In the interim they should be placed in centralized locations, such as the department secretary's office or computer room, and serviced by a dedicated machine or connected to multiple systems via a switch or a device sharer (38:--; 96:--). Developments in high-resolution LED and ink-jet printers should be monitored since these technologies appear to have the potential for high quality, bit-mapped printing jobs currently reserved for laser printers (87:--).

14. Set up a desktop publishing system and evaluate its use in publishing course materials, manuals, slides, etc. This could be done by acquiring the desktop publishing software only, using an existing Z-158 system. Use of a laser printer rather than a dot matrix printer is strongly preferred. Ideally, the host system should also have an EGA or Hercules display system or better and an 80286 processor. Ventura Publisher or Aldus PageMaker are recommended as DTP packages, with the edge going to Ventura Publisher on the basis of features and adequate performance on XT class machines (79:132; 95:--; 113:--; 122:--).

15. Procure a CD-ROM system and software to gain experience with this technology and evaluate its potential as computer-compatible medium for distributing and accessing documents, multimedia, databases, software, and CAI materials and for establishing functional libraries (161:--). Recommended initial software includes Microsoft Bookshelf (67:--; 68:--) and the PC-SIG library (170:--). The later item could be used to establish a public domain/shareware software library for use by ACSC personnel.

16. Start experimenting with authoring course materials in hypertext format with storage on floppy disk or disk cartridge. Initially such documents may be useful as supplementary materials for use on seminar room systems or home machines. In the long run, delivery of course materials in hypertext on CD-ROMs may be viable for ACSC resident and associate programs.

17. Consider replacing Smart wordprocessor with a more popular, full-featured wordprocessor, such as WordPerfect or Microsoft Word, as the standard wordprocessor for use at ACSC. (This is aimed at improving compatibility with other popular software and the availability of advanced features, integrated CAW tools, add-on products, third party documentation, and updates and hardware support in the future.)

18. Delete PC-Read and PC-Style programs from standardized system disk configuration. (See evaluation in Chapter 3.)

19. Students should be briefed on computer resources available for supporting writing, research, graphics, and publishing. A short guide on ACSC and other AU computer support should be prepared, including brief instructions on how to use the Smart wordprocessor, to access the AU Library via modem, etc.

20. Access to the ACSC building and student computer systems should be improved after normal duty hours. This may eliminate the need to acquire portable computer systems for loan to students and increase the use of existing resources.

Chapter Six

SUMMARY AND CONCLUSIONS

In this report we have presented a brief survey of computer-aided writing tools for personal computers. We have identified and discussed ten basic categories of tools for assisting in the various stages of the writing and publishing process: outline processors and prompting programs, wordprocessors, style and grammar checkers, spelling checkers and thesauri, miscellaneous utilities, communications software, on-line research systems, publishing and typesetting aids, and hypertext systems. We have discussed in greater detail the capabilities and limitations of selected current offerings in several of these categories, namely, wordprocessors, outline processors, and style and grammar checkers. We have also presented general factors to be considered when selecting CAW tools. Finally, we briefly reviewed support for computer-aided writing at ACSC and made recommendations for improvements in this area.

The various categories of CAW tools are currently at widely different stages of maturity, sophistication, and utility. The better wordprocessors, spelling checkers, and electronic thesauri are already well developed and represent valuable tools to their users. Other products, such as style and grammar checkers, are immature and of limited utility in their current implementations but have the potential for developing into truly useful tools in the near future. Still other tools, such as logic analyzers and prompting programs, do not appear practical in the near term.

We have noted an apparent trend toward integration of the various CAW tools into wordprocessors and the transformation of high-end wordprocessors into full document preparation system. For example, most of the leading wordprocessors have already incorporated spelling checkers and thesauri and are planning to add desktop publishing capabilities. This development is taking place at a rapid rate and should blur the distinction between various classes of tools and reduce the need for standalone products. The requirement for preparing documents is almost universal among most professionals. The high utility and increasing functionality of wordprocessors places great importance on the choice of an appropriate wordprocessor. In general, we recommend selection of one of the leading, full-featured wordprocessors, such as WordPerfect or Microsoft Word, to assure the best levels of performance and support both in the present and future.

Many CAW products are strongly influenced by or are dependent on new hardware and software technology, such as laser printers, high resolution graphics, or artificial intelligence. For example, current desktop publishing and typesetting programs are capable of producing substantial improvements in the appearance of final documents produced with personal computers but require an expensive investment in new, higher performance hardware. Similar requirements are likely to spread to wordprocessors in the near future in order to take advantage of advanced capabilities, such as integration of graphics and text. This trend toward increased system requirements, particularly graphics, will be accelerated by other developments, such as Windows, OS/2, and other applications software. To take advantage of these developments, it will be necessary to replace or upgrade existing, low performance systems with improved processor, memory, display, and printer subsystems.

Current support for CAW at ACSC consists primarily of use of the Smart Word Processor on Z-100 and Z-158 PCs. This report recommends acquisition of laser printers, processor and display upgrades, and a LAN to provide the computer environment needed to support publishing and to meet the requirements of future wordprocessors and other applications and system software. Technologies which deserve special consideration include desktop publishing, CD-ROMs, and hypertext. This report suggests that primary emphasis be placed on providing computer-assisted writing and publishing support for faculty and staff rather than the student body. Given the current state of CAW software and logistical problems associated with support of a large student body, the report does not recommend any significant changes to the curriculum or computer environment for students at the present time.

CAW tools represent significant current and potential aids for writing and publishing. We have identified and reviewed some of the more significant current products and trends in this report. However, because of the very dynamic nature of this field, the sources referenced in this report should be monitored to determine subsequent hardware and software developments.

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